ILab600 Service Manual

Revision 0 - July 1998

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1 Introduction

1.1 General description

The ILab600 is an automated, random access clinical chemistry analyzer which uses analytical techniques (photometry and potentiometry) for the *in vitro* quantitation of analytes found in physiological fluids, such as serum, plasma, urine or cerebrospinal fluid. The results of the measurements are used as medical diagnostic tools.

The following description of the ILab600 system is intended to familiarize the user with its physical layout and configuration.

1.1.1 Models

The ILab600 system is available in four models, defined by the optional modules present on the basic unit.

- ILab600 system
- ILab600 with ISE module
- ILab600 with Sample Stirrer Module
- ILab600 with ISE and Sample Stirrer Module.

All models have the following common standard features:

* Random access to samples on board
* Random access to 64 reagents on board
* Primary tube sampling and positive sample ID
* Stat sample analysis capability
* Barcoded reagents, including reagent ID, lot number and expiration date
* Programmable automatic startup
* Automatic shutdown and maintenance
* Operator interface using a Pentium PC working on a Windows™ NT environment

* Integral data management, including comprehensive QC package
* RS232-C bidirectional interface allowing host query from an LIS

1.2.2 Hardware Configuration

The ILab600 consists of two major distinct modules – the Analytical and the Operational Modules – which are electronically connected to each other. A main ON/OFF power switch located on the left side of the Analyzer affects both units simultaneously. However, turning this switch OFF does not affect the operation of the reagent compartment cooling unit. This feature allows the preservation of reagent integrity regardless of the status of the instrument.

- The Analyzer is where the sampling and analyzing operations take place. In order to place specimens and reagents or to perform troubleshooting operations the operator must gain access to the top of this module by lifting a molded plastic cover. This cover is maintained closed at all other times to protect the moving mechanisms from the environment.
- The Operational Module, which includes the System PC and a Printer, allows the operator to interface with the system to program all the automated operations performed by the ILab 600.

The Analyzer Module

The Analyzer front view is made of three distinct areas:

* the top part, where the sampling and analysis mechanisms are located.
* the lower right portion, accessed through a hinged door, houses the fluidic metering and control system providing water to the sample and reagents syringes
* the lower left area also accessed through a hinged door, includes the power supply and electronics.

Main modules of the Analyzer module are the following:

* sample compartment housing the sample tray (for specimens in primary tubes and/or sample cups) and adjacent sample dispenser arm
* cooled reagent compartment, housing the reagent tray and the two adjacent reagent dispenser arms R1 and R2
* photometric analysis module, which includes the reaction cells (cuvettes) tray, the cuvette incubation water bath (incubator) and the photometer

Figure 1.1 - ILab600 front view

* cuvette washing unit above the analysis area
* stirrer for mixing sample and reagents inside the cuvettes
* optional sample stirrer module to perform sample dilutions in sample cups
* optional ISE module to perform potentiometric measurements of sodium, potassium and chloride

The schematics of the analyzer rear view (Figure 1.2) show the location of the major electrical and mechanical system components:

* on the right side, the electrical system components include: signal ports for the PC and the water supply unit, the cooling fan for the instrument, the power cord, the main breaker (to turn off the entire system) and the PC power supply for the PC and the printer
* on the bottom left side are the external water inlet port, the drain port, the biological waste drain port and the signal port for the waste tank level sensor.

The Operational Module

The ILab600 operator controls the operations taking place in the analytical unit from a stand-alone PC system, via a Windows NT based operator interface. A printer allows the user to obtain hard copies of calibration, QC and patient reports.

Figure 1.2 - ILab600 rear view

1.2 Supplies and Accessories

The following accessories and disposable supplies are required for operating the ILab600 and are exclusively distributed by Instrumentation Laboratory.

1.2.1 Sample Cups

Specimens may be placed in disposable plastic sample cups, which are held in any position of the sample tray. Calibrators and controls are always placed in these cups.The specifications of this container are:

* Sample cups - Cat.No.182629-03 (8,000 pieces/pack)
– Size: 2.0 mL
– Dead volume: approximately 20 uL

Note: The standard sample cup fits on top of sample tubes in the sample tray, thus allowing the sample to benefit from the positive ID feature, as the barcode label may be affixed **on the** tube.

1.2.2 Reagent Containers

The ILab600 can accommodate both 20 mL and 100 mL reagent containers (Figure1.5). ILab reagents are supplied pre-packaged in these containers, already barcoded for automatic identification of reagent ID, lot number and expiration by the instrument. Empty reagent containers can be obtained from IL for use with non-IL applications:

* 20 mL BoatIL™ container, Cat.No. 182629-02 (20 pieces). To place this reagent container in the inner ring of the reagent tray, use the long plastic adapters supplied with the system. To place this container in the outer ring of the reagent tray, use the short plastic adapters supplied with the system.
* 100 mL BoatIL™ container, Cat.No. 182629-00 (20 pieces). Requires no adapter.

1.3 Instrument Functional Overview

The basic ILab600 allows the random access analysis of up to 100 tests per sample or group of samples, with a throughput of 400 tests per hour. In the models which include ISE, the throughput is increased by an additional 400 ISE tests per hour.

The samples, calibrators and controls are loaded randomly in a 75-position sample tray, which can hold either primary collection tubes or standard sample cups. The samples are arranged in three concentric circles and do not need adapters. A barcode reader for positive sample identification is capable of accessing the middle and outer circles containing a total of 60 positions.

The reagents, which are prepackaged in 20 mL and 100 mL barcoded reagent containers, are placed in a 64 position reagent tray which fits in a cooled (5 to 15^{o}C) reagent compartment. A reagent barcode reader identifies the reagent, its lot number and expiration date, all of which are stored in the system memory. The number of on-board tests for each reagent container is determined through reagent probe level sensors.

Following the operator's request from the stand-alone PC system, or from the LIS downloaded worklist, samples and reagents are aspirated from their respective containers and dispensed into the cuvettes. The 81 Pyrex® cuvettes rotate in a 37^{o}C ± 0.1^{o}C water incubator, near the photometer. The loading process involves the use of one sample and two reagent-dispensing arms driven by positive displacement syringes. Sample volumes range between 2 and 40 uL per test and reagent volumes vary between 20 and 400 uL per test for up to 4 reagents, as predefined in the test parameters. After the sample and reagent(s) are dispensed into each cuvette, a stirrer mixes

them prior to the photometric measurements. The reaction is monitored at set intervals (33 data points for reactions involving up to 2 reagents, for a total of 9.6 minutes and 74 data points for reactions involving up to 4 reagents, for a total of 21.8 minutes) by a stationary photometric system. The system includes a holographic grating and photodiodes array detector which measures at 12 set wavelengths ranging from 340 to 850 nm. After each reaction is complete, the cuvette is emptied and washed by a system of washing and drying probes using a combination of detergent and water.

In systems including the ISE module, Na, K and Cl in the sample can be in parallel to the photometric measurements. The sample is aspirated by a dedicated sample probe, diluted 1:21.7 with an on-board diluent, and is directed to flow in front of the three ion selective electrodes for quantitation.

When the measurement is complete, the results can be viewed in the ILab screen and can also be sent to the system printer and/or downloaded to the DMS if the system is so configured.

The software-driven operation described above is carefully synchronized to achieve a high degree of productivity and efficiency. Modifications of the basic described sequence take place when required by the interruption of Stat samples, or by added steps such as automatic sample pre-dilution in the cuvette.

1.4 Instrument Specifications

1.4.1 Sample and Reagent

Mechanism of delivery**:** Digitally controlled positive displacement syringe.

Reaction volume:

* Minimum total volume: 180 uL
* Maximum total volume: 500 uL

Sample volume: Photometric sample volume is under computer software control and is adjustable in 1 uL steps through a range of 2-40 uL. ISE sample volume is fixed at 24 uL.

Sample overfill: 10 uL of sample are aspirated as overfill volume at the first aspiration for each sample.

Reagent volume: Total reagent and diluent dispensing volume are under computer software control and are adjustable in 5 uL steps through a range of 20-400 uL. This applies to Reagents 1,2,3 and 4.

Inaccuracy of Sample Measurement: typically 3% or less at 2 uL or more

Imprecision of Sample Measurement: typically 1.5% or less at 2 uL or more

Inaccuracy of Reagent Measurement: typically 2.5% or less at 30uL or more

Imprecision of Reagent Measurement: typically 1.2% or less at 30 uL or more

Reagent volume required for Priming and/or Dispensing: Reagent required for priming varies from 5 to 20 uL per test depending on the reagent volume which is aspirated. In the case of reagent automatic dilution, no reagent priming volume is aspirated. No reagent is required for flushing.

Reagent Corrosion Precautions: Reagents contact only surfaces made of stainless steel, Teflonâ and polyethylene tubing, and Pyrex glass. Specific precautions for each reagent are listed in the corresponding kit's insert sheet.

Carryover of Analyte and Reagent: Typically 0.002% or less

1.4.2 Photometric Reaction Vessel

81 Pyrex glass cuvettes arranged in a circle; optical pathlength 5 mm.

1.4.3 Ion Selective Electrodes

Chloride: quaternary ammonium salt ion exchange membrane electrode

Potassium: valinomycin liquid membrane electrode

Sodium: crown ether liquid membrane electrode

Reference: silver/silver chloride electrode

1.4.4 Optics

Photometry:
Computer selected wavelengths (340-850 nm) using a concave holographic grating and 12 narrow- wavelength photodiode detectors

Photodiode wavelengths available: 340, 375, 405,450, 510, 546, 570, 600, 660, 700, 750, 850 nm

Wavelength accuracy: ± 3 nm at all wavelengths

Half Band Width: less than 10 nm

Light source: Halogen lamp (20 W)

1.4.5 Sample and Reagent Barcode Readers

The Sample and Reagent barcode readers are Class 2 Laser Products which conform to IEC 825-1 11.1993.

Light Source Laser beam

Emitted wavelength 670 nm

Maximum output 1.2 mW

Pulse duration 127 micro seconds

10.6 seconds to 21.8 minutes, with 17.9 seconds between

The Barcode readers recognize the following barcode types:

* Interleaved 2 of 5 (ITF)
* Code 39
* Codabar (NW-7)
* JAN

The maximum number of digits allowed for a Sample barcode is 16.

The maximum number of digits allowed for a Reagent barcode is 18.

1.4.6 Instrument Dimensions, Weight and Power requirements

Dimensions and Weight:

Width	980 mm	38.6 in
Depth	760 mm	29.9 in
Height	1180 mm	46.5 in
Weight	300 Kg	660 lb

Power Requirements: 230 VAC ± 10%, 50/60 HZ, 2 KVA

Power consumption: 1.6 KVA

Power inlet protection: Magnetic-thermal breaker 10 Amp

1.4.7 Interface Specifications

Interface**: Bidirectional DMS communication**

Interface parameters are user selectable via the software

Host query function

Interface Standard**: RS232-C**

DMS: included in the system with functions such as:

* Data Storage for 4800 requests

* Patient Reports
* QC program with daily and monthly statistics
* Monitoring of entire reaction

1.4.8 System Timing

Minimum Lag Time in seconds between start of Reaction and First possible reading:

10.6 seconds after dispensing first reagent

13.0 seconds after dispensing second reagent

10.6 seconds after dispensing third reagent

13.0 seconds after dispensing fourth reagent

Range of controllable Reaction Interval (incubation time):

10.6 seconds to 21.8 minutes, with 17.9 seconds between consecutive readings.

Range of Total Reaction time during which measurements can be made:

For 2 reagent tests: 10.6 seconds to 9.6 minutes, with 17.9 seconds between consecutive readings.

For 4 reagent tests: 10.6 seconds to 21.8 minutes with 17.9 seconds between consecutive readings.

1.4.9 Water Consumption Specifications

The system utilizes deionized water with a minimum resistivity of 1MOHM/cm (conductivity of 1.0 mS/cm or below) and inlet pressure of 0.5 – 3.5 Kg/cm^2. Water consumption when the ILab is active is about 24 L/hour.The water is used as follows:

1. Degassed water for washing cuvettes:

   Probes 1, 2, 3 dispense 2 mL- two times in each cuvette

   Probe 4 dispenses 1.5 mL- one time

   Total volume used: 13.5 mL/cuvette

2. Degassed water for rinsing interior surface of dispenser probe:

   Sample: 0.65 mL

Reagent 1 and 2: 1.65 mL each

Total volume used: 3.95 mL/cycle

3. Deionized water for rinsing exterior surface of dispenser probes and stirrers:

   Sample: 1.8 mL

   Reagent 1 and 2: 3.6 mL each

   Stirrer 1 and 2: 8.2 mL each

   Total volume used: 25.4 mL/cycle, for a 2-reagent test

1.5 Safety Certification

1.5.1 CSA Certification

The CSA label on the back of the instrument indicates that the ILab 600 analyzer has been tested by the Canadian Standard Association.

Applicable standards:

- CAN/CSA C22.2 No. 1010.1-92
- UL Std No. 3101-1

ILab system Certificate No. LR 103292-2

1.6.2 CE Certification

The CE label on the back of the instrument indicates that the ILab 600 analyzer conforms to the Electromagnetic Compatibility Directive 89/336/EEC and 92/31/EEC and to the Low Voltage Directive 73/23/EEC and 93/68/EEC.

Applicable Standards:

- EN 55011 - 1991 (Group 1, Class A)
- EN 50082/1 - 1992
- EN 61010-1 : 1993 and Amendment 2 : 1995

ILab system Certificate No. ME-150005

2 Installation

Complete installation of ILab600 system should be managed as follows:

1. Preinstallation visit:

In order to arrange and set with the customer all the items required for the ILab600 system installation, a preinstallation visit should be carried with a reasonable advance on the foreseen installation date. Main activities of the preinstallation visit are:

a. Overview of the laboratory environement

b. Define with the customer the actions to be set in the lab in order to fit the system requirements

c. Define with the customer the final ILab600 layout in the lab

Details on the preinstallation visit are reported in section 2.1 (and subsections) below.

2. Installation

The installation protocol includes all the procedures describing the system unpacking, interconnection, and verification. Time required for a complete ILab600 system installation is 1/1.5 days. Installation procedure is reported in section 2.2 (and subsections.

2.1 Preinstallation visit

During the preinstallation visit the laboratory area should be inspected in the light of the following requirements:

2.1.1 Working area

The working area has to meet the following conditions:

a) No presence of intensive strong magnetic field, electric field, or high frequency wave.

b) Free from vibrations

c) Horizontal floor (slope under 1/200)

d) No presence of corrosive or inflammable gas

e) Presence of good ventilation and no or little dust

f) No direct exposure to sunshine

g) Floor rigidity sufficient for supporting instrument weight (300Kg)

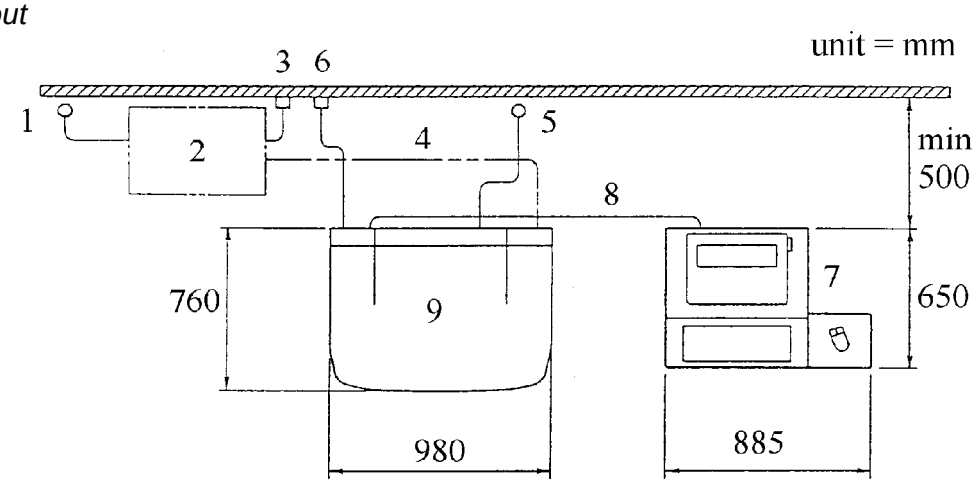
h) Roomtemperature: The system can operate, to specification, in an ambient temperature range from 15°C to 30°C with variations within +/-3°C/hour and relative humidity in the range of 45-85% (non condensing). The system generates the following amount of heat: 1.6 KW = 1376 Kcal. If necessary an air conditioning system has to be foreseen.

The temperature in the room should never to drop below 0°C.

2.1.2 Accessibility to the system

The ILab600 system is consising of the analyzer and the personal computer controller.

Figure 2.1
Suggested layout



1 - Pure water tap
2 - Water Deionizer system
3 - Water Deionizer mains power supply connection
4 - Pure (deionized) water tubing, max lenght mt 5
5 - Drain port, max lenght of drain tubing mt 5
6 - ILab600 mains power supply connection (dedicated line), max lenght of mains cable mt 5
7 - ILab computer controller (includes PC with keyboard & mouse, printer, VDU)
8 - Cable interconnection ILab600/PC, max lenght mt 2.5
9 - ILab600 system analyzer

Physical dimensions of the system analyzer are the following:

Width:	980mm	38.6inches
Height:	1180mm	46.5inches
Depth:	760mm	29.9inches
Weight:	300Kg	660Lbs

Personal Computer controller should be placed over a desk or stand provided by the customer. PC controller is conneted to the analyzer by a cable (lenght 2.5 mt).

Full accessibility to the entire perimeter of the instrument is required for operator routine, maintenance and service purposes.

Figure 2.1 shows the minimum area recommended for ILab600 systems installation.

2.1.3 Electrical requirements

The instrument has been designed for operating in connection with a standard grounded main supply line of 230 VAC +/-10%, 50/60 Hz.

The power requirement is 2 KVA

The Mains supply power has to be free from microinterruptions and/or significant overvoltage spikes. If "noisy" mains is suspected, an extensive testing by a Mains Power Recorder has to be performed (indicatively, monitor the mains power over at least one week, 24 hours/day). If required, implementation of an UPS system should be foreseen.

A dedicated mains supply line has to be provided for the ILab600 supply. Mains supply cables have to be properly rated.

NOTE: testing of the Mains power should be performed in the Mains supply line of the ILab600.

Presence of an appropriate power switch is required within the distance of 5 meters from the system.

A dedicated grounding with impedence lower than 10 OHM is also required.

If a Deionizer Unit is installed, it is required an additional mains line supply for deionizer unit supply.

2.1.4 Water supply

The system, in order to operate properly, requires to be supplied

by pure deionized water respecting the following specifications:

- Conductance has to be 1mS/cm or lower

- Supply water has to be pressurized within the range of 0.5 to 3.5 Kg/cm.

- Pure deionized water shall be obtained from an R.O. deionizer system, or at least shall be distilled water for laboratory use.

- Typical water consuption during analysis cycle is:

24 liters/hour

- The supply port has to be sized for accepting the ILab inlet tubing. Inlet tubing specifications are:

Inner diameter: 9 mm

Outer diamenter: 15.3 mm

- The source of pure water shall be located at no more than 5 mt from the system.

The deionizer unit is an option.

A 24VDC 300mA (max) (TBC) signal is available for driving the deionizer system. If a local deionizer is used, it is recommended, for safety reasons, that the water inlet pipe and the mains power supply of the deionizer be controlled (by a solenoid valve and a relay) together with the ILab600 system.

2.1.5 Drain line

A drain line which collects the waste from the system is to be foreseen, and must be placed near the system drain outlet (within five meter maximum)

As the waste is evacuated per gravity, the waste port should be located at floor level.

The drain line should be capable to evacuate the volume of 50 liters/hour of waste, and the port diameter has to be large enough to be connected with the system drain plumbing, which has an external diameter of 33 mm. it is suggested a diameter of 50mm.

If an R.O. water deionizer system is being used, a water drainage capable to meet the requirements of such a system shall also be foreseen.

2.1.6 Biological waste

ILab600 system is designed to separate the biological waste from the total waste obtained on the rinsing/maintenance cycles.

The system is provided by an external tank for collecting all the biological waste.

Total waste produced during analysis cycle is approximately 24 liters/hour.

Biological waste produced during analysis cycle is approximately 0.75 liter/hour.

The external tank is provided by a level sensor that is triggered as the waste volume is reaching approximately 16/17 liters full. As than full is detected, the system continues to run up to the end of the routine in progress, then instrument status is switched to "pause"

2.1.7 Requirements for reception area and transporting pathway

A suitable area must be available to receive, stock and uncrate the system upon arrival. Physical dimensions of the crates are:

	Box 1		**Box 2**	
Width:	115cm	45.3inches	104cm	41inches
Height:	151cm	59.5inches	89cm	35inches
Depth:	97cm	38.2inches	85cm	33.5inches
Weight:	430Kg	946Lb	100Kg	220Lb

In order to be able to transport the system from the reception area to the installation room, please consider the following steps:

a) The various units of the system will be uncrated in the reception area.

b) The minimum acceptable width along the transport path (i.e. doors, lift, etc) is 800 mm.

c) Should the units be carried along a stairway, they have not to be inclinated more than 10°.

d) Mechanical chocks during the transport may produce severe damage to the units

e) It is recommended that the path from reception area to the installation room be preliminary checked during preinstallation visit.

2.1.8 DMS interconnection

The interconnection of the ILab600 to a Data Management System should be foreseen and defined at this step.

2.1.9 Telephone line

The ILab600 system is provided of a remote control option, which may be used for various purpuses (i.e. service troubleshooting, parameters downloading, etc). In order to optimize the use of the remote control option, a dedicated telephone line should be provided. The telephone line should be permanentely connected to the ILab600 system.

2.1.10 Preinstallation visit check list

The check list in the next pages should be photocopied and used as a reminder during the preinstallation visit.

ILab600 system pre-installation check list

Customer	
Contact person	phone
FSE signature	customer approval

1	**Working area**	Checked
1.1	*Absence of strong magnetic electric fields or HF waves*	*O*
1.2	*Free from vibrations*	*O*
1.3	*Floor flatness (slope lower than 1/200)*	*O*
1.4	*Absence of corrosive or inflammable gases*	*O*
1.5	*Presence of good ventilation and no or little dust*	*O*
1.6	*No direct exposure to sunshine*	*O*
1.7	*Temperature variation within specifications*	*O*
1.8	*Is an air conditioning systeme required? Yes O No*	*O*
2.	**Electrical power requirements**	
2.1	*A dedicated power supply line rated for 2KVA shall be foreseen*	*O*
2.2	*Laboratory grounding shall have impedence lower that 10 Ohms*	*O*
2.3	*Mains power interconnection shall be located at less than 5mt*	*O*
2.4	*If a deionizer is foreseen, a 2nd power supply line has to be set-up*	*O*
2.5	*As the dedicated mains line is set-up, mains shall be monitored*	*O*
2.6	*A UPS unit is foreseen Yes O No*	*O*
3.	**Water supply requirements**	
3.1	*Source of P.W. shall be located at < 5 mt from the ILab600*	*O*
3.2	*Quality of pure water provided by the lab meets the ILab requirements*	*O*
3.3	*Pure water shall be provided at a pressure between 0.5 to 3.5 Kg/cm*	*O*
3.4	*The source of pure water is able to supply at least 24 liter/hour*	*O*
3.5	*The P.W. port has to be sized according to the diameter of the ILab pure water inlet tubing which has an internal diameter=9mm*	*O*
4	**Drain line requirements**	
4.1	*The drain port shall be located at ground level*	*O*
4.2	*Drain port shall be placed at less than 5 mt from the ILab*	*O*
4.3	*Drain line shall be capble to evacuate more than 50 liters/hour*	*O*

4.4	*Diameter of drain port shall be sized to be connected with the ILab waste tubing which has an external diameter of 33mm*				*O*	
4.5	*If a R.O. deionizer shall be used, drain line shall be foreseen*				*O*	
4.6	*Is the use of biological waste option kit required?*	*Yes*	*O*	*No*	*O*	
5	**Reception area and pathway**					
5.1	*A suitable area is available to receive, stock and uncrate the ILab*					*O*
5.2	*The transport pathway allows moving the ILab to the lab*					*O*
6	***Others***					
6.1	*Has the interconnection with a DMS system been defined?*					*O*
6.2	*Has a telephone line for remote control been foreseen?*					*O*

Draft the final laboratory layout, indicating, in scale, the location of the following items: ILab system, ILab power supply port, Pure water port, Drain port/s, R.O. deionizer (if any), R.O. deionizer water/mains supply ports (indicationg also if deionizer control by the ILab will be realized), UPS (if any), air conditioning system (if any).

warning: **leave one photocopy of the final installation check-list (including laboratory layout) to the customer for reference.**

2.2 Installation procedure

2.2.1 Unpacking and inspection

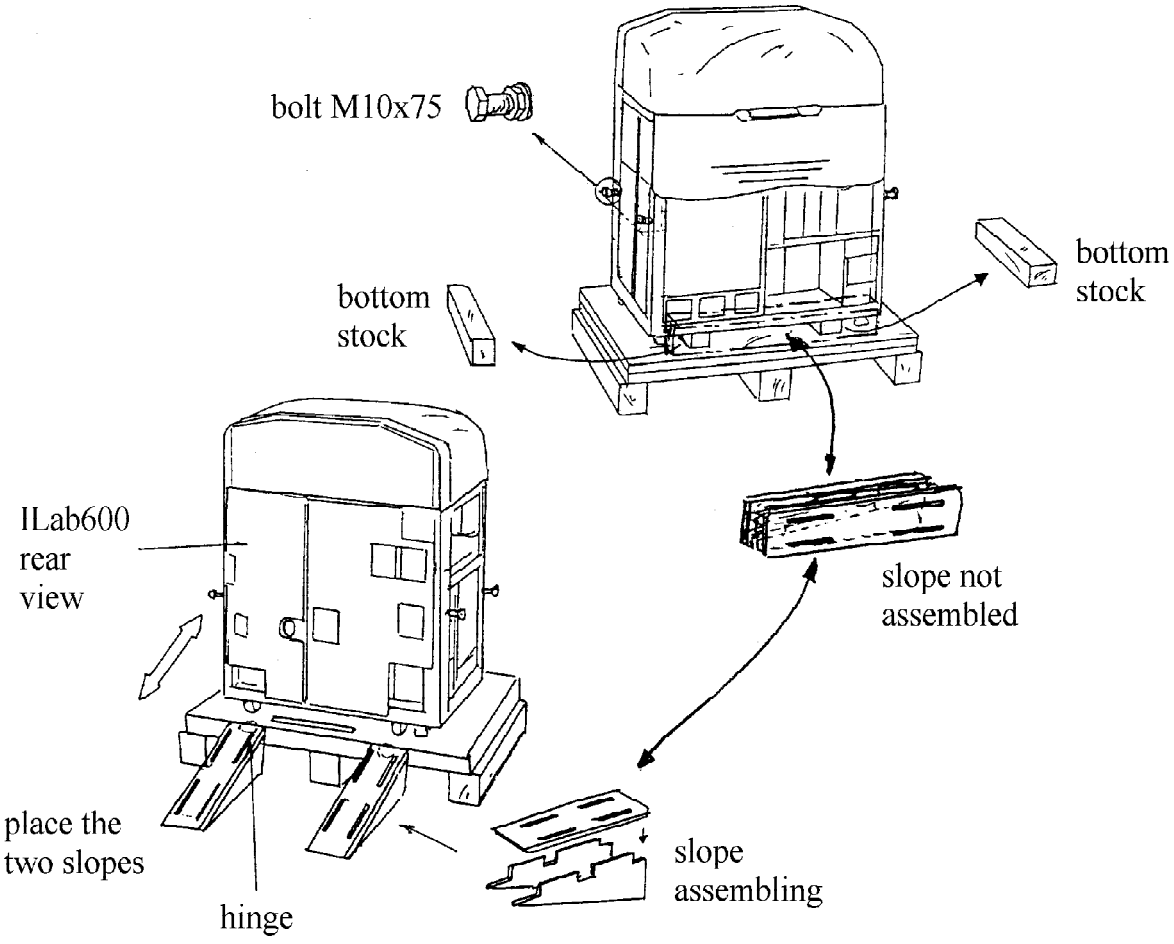
Carefully inspect the creates for damage. If any damage is noted, notify the carrier immediately.

The crate is equipped by a tilt detector. Verify the tilt detector status.

If no sign of damage is seen, then carefully uncrate the units and unpack the accessories. For uncrating the system, first remove the top cover, then the four side covers.

As the top and side covers of the box have been removed, remove the two bottom stocks from the bottom of the ILab, assembly the two slopes, set the slopes into the hinges and carefully drive the system from the wooden base to the floor pushing the system on the four bolts. (refer to figure 2.3).

Figure 2.3 - ILab uncrating



Remove the four bolts from the ILab chassy.

Verify that all the parts listed in the packing lists are included in the packings. Packing list documents are included in the accessories packings inside the crate.

A copy of packing list is reported here below. Be aware that the content of the packing list may be modified without notify, therefore, on installation, refer to the packing list included in the instrument crate.

#	IL P/N	Shmdz P/N	Description	Quantity
1		241-01000	Analyzing module	1
2		241-01044	Terminal assy	1
3		N.A.	Cover set	1 set
1)		241-01124	Front cover	2
2)		241-01095	Side cover, R	1
3)		241-01109	Side cover, L	1
4)		241-01174	ISE cover	1
4		241-01550	Reaction tray	1
5		241-01340	Reagent tray	1
6		241-01240-01	Sample tray (N°1)	1
7		241-01015	ILab600 standard accessories	1 set
1)		038-03005	Tool box B85	1
2)		241-94041	Standard tool	1 set
3)		206-40481-02	Set of wires	1
4)		204-62691-01	Syringe sealer sample	1
5)		204-63691-02	Syringe sealer reagent	1
6)		241-95010	Lamp PG64258/ME-MLP	1
7)		241-92594-01	Bottle, 20ml (10 pcs)	1
8)		086-16101	Pincette AA	1
9)		241-01327	Reagent adapter inner 20ml	10
10)		241-01326	Reagent adapter outer 20ml	32
8		241-01012	Installing parts	1 set
1)		241-01013	Tube assy IN	1
2)		241-01158	Drain port assy	1
3)		241-01073	Panel (bracket for drain port)	1

#	IL P/N	Shmdz P/N	Description	Quantity
4)		241-90005-04	Tube 5000 (for drain, 5mt)	1
5)		037-61028	Tube clamp HB-1-36	1
6)		241-96181-01	Cable for personal computer	1
9		241-01003-01	Waste tank set	1
1)		241-02200-01	Waste tank level sensor	1
2)		241-02204-01	Waste tank	1
ISE ACCESSORIES				
1		240-04016	High cal pot packing	12
2		204-63691-01	Syringe sealer sample 1.6	1
3		206-45878-01	ISE Syringe sealer 7.28	1
4		206-45878-02	ISE Syringe sealer 5.05	2
5		206-45727-02	ISE probe sealer	3
6		638-43755	Electrode sealer	1
7		240-07061	Tube clamp	1
8		241-90003	Dummy electrode	1

2.2.2 System interconnection

Open all the accessory crates and assembly the system (refer to fig 2.4 and 2.5) in the following sequence:

a. Check all PCBs, connectors and of the ILab600 system are securely fastened.

b. Check that the internal tubings and the tubings metal ties are securely fastened.

c. Unpack and install reaction, sample and reagent trays.

d. Unpack the hinges and the magnetic latches of the front doors (they are pached and fixed by adehesive tape in the front of the system, in the area below the syringe modules).

e. Install the two front doors.

f. install the two side covers.

g. Unpack and install the personal computer, the printer and the CRT. Connect to the ILab system by using the Terminal assy and the signal cable.

h. Install the Drain port assy to the rear of the ILab600. Connect the drain plumbing between the ILab drain port and the drain line

of the laboratory.

i. Install the Tube assy inlet at the Pure water inlet port at the rear of the ILab system. Connect the other end of the tube assy inlet to the Degassed water source.

l. Install the ISE electrodes.

Figure 2.4 - accessory unpacking and installation

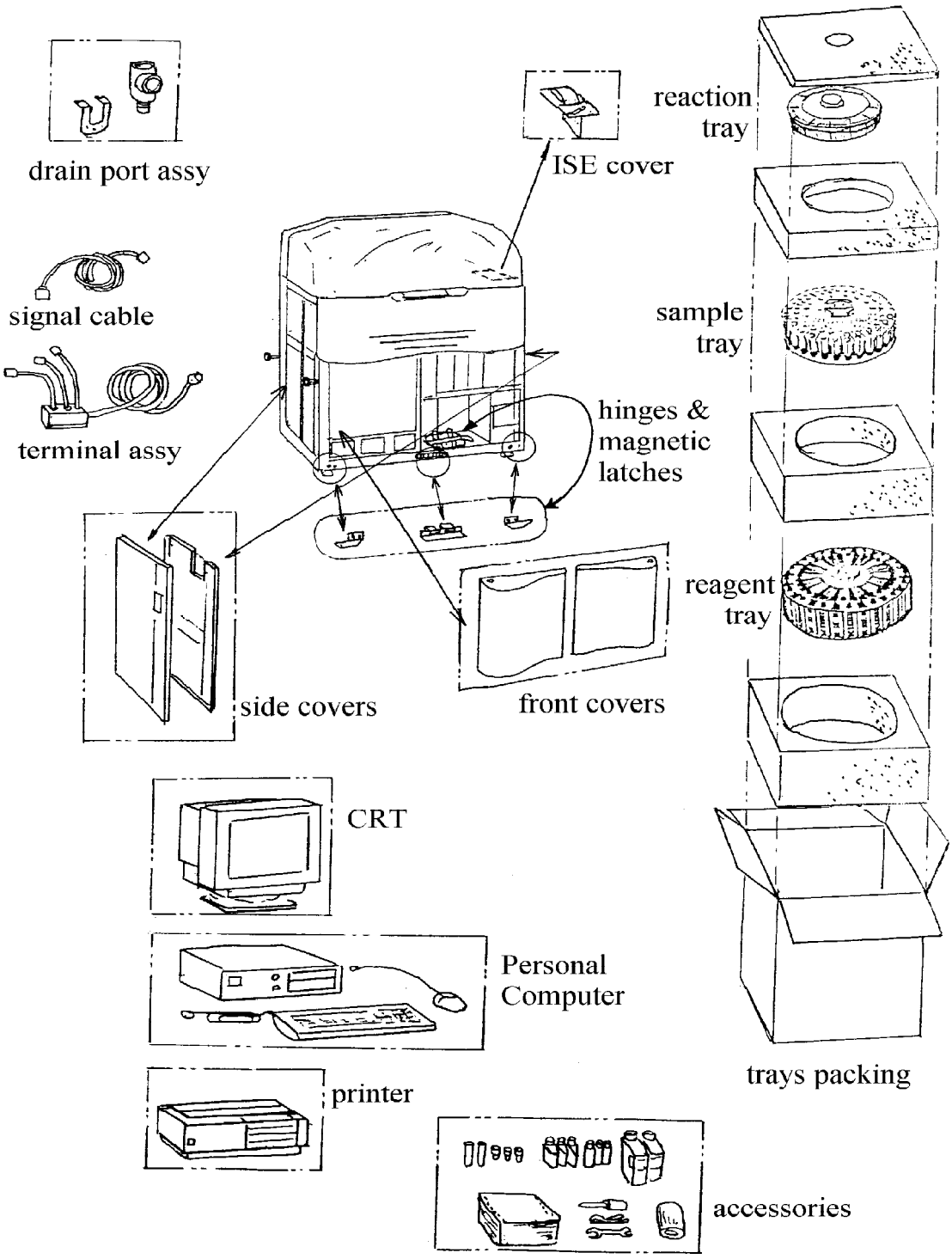
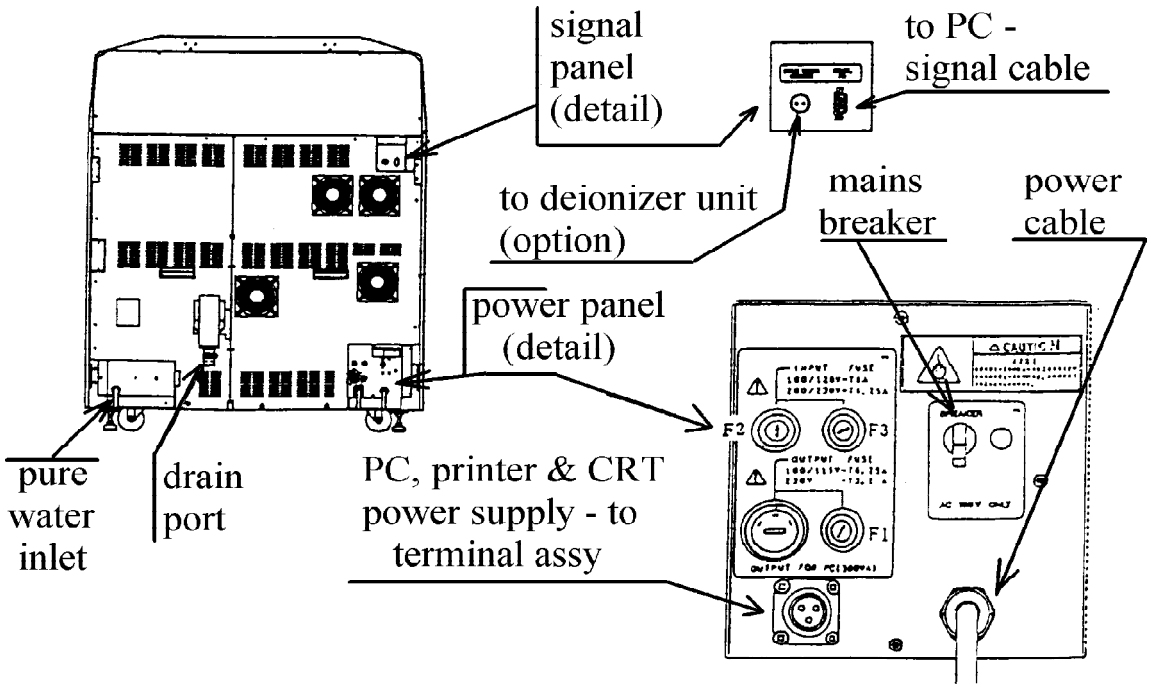


Figure 2.5 - Rear system interconnections



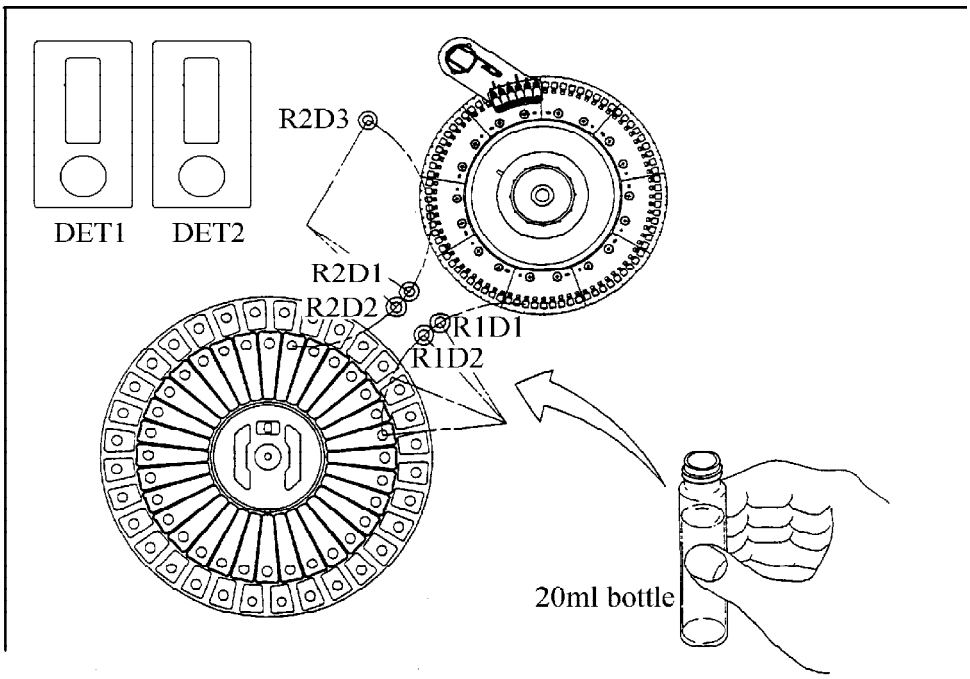
m. Install the ISE reagents & solutions: place Slope solution (100ml bottle) in its housing on the top panel of the analyzer, nearby the ISE sample probe. Place Reference Solution (1l bottle). Place Calibrator (1l bottle) and Diluent (2l bottle) in their housing behind the analyzer right front door.

n. Prepare the detergent solutions indicated in the table below:

P/N	***Description***	***Quantity/Concentration***	***Location***
00000000	*New Acid S*	*1 liter bottle, concentrate*	*Detergent 1*
	New Alkali S	*1 liter bottle, concentrate*	*Detergent 2*
	New Alkali	*20 mL bottle, 2% dilution*	*R1D1*
	New Acid	*20 mL bottle, 2% dilution*	*R1D2*
	New Alkali	*20 mL bottle, 2% dilution*	*R2D1*
	New Acid	*20 mL bottle, 2% dilution*	*R2D2*
	New Clean	*20 mL bottle, concentrate*	*R2D3*

Place the detergent solutions in the specific locations as indicated in figure 2.6.

Figure 2.6 - Detergent solutions



2.2.3 Personal Computer installation

a. Installation of Windows NT (if needed)

b. Configuration of the accessories (printer, modem, auto-login)

c. Installation of ILab600 software program

d. Connection of the PC to the ILab600 (mains power to terminal assy and signal cable)

2.2.4 System verification prior Power ON

a. Check groundings: measure resistance between the instrument chassy and the ground wiring of the mains supply cable. The value measured should be lower than 0.2 OHM.

b. Check water pressure: the pressure at the ILab Pure Water Inlet should be in the range of 0.5 to 3.5 Kg/cm2.

c. Check that the Inlet Voltage selectors (2 selectors, located in the box located at the rear of the Solid State Relay pcb, ref. to Interconnection Diagram 9) are set to 230 VAC. Check that the Voltage Selector of the Terminal assy (located at the bottom rear of the system) is set according to Printer, VDU and PC supply voltage (typically 230VAC).

2.2.5 System start up

a. Connect the mains supply cable to the mains line supply

b. Switch ON the mains breaker located at the rear of the system

c. Switch ON the power switch located at the right side of the analyzer. The system performs automatically the software program downloading and the mechanical inizialization.

2.2.6 Electrical verifications

a. Measure the DC voltage of the following PCBs:

Board	Location		Nominal VDC	Range
Temperature contr. pcb	*CN2/CN3*	*Pin 1-2*	*+5VDC*	*+4.9¸ +5.2*
Temperature contr. pcb	*CN2/CN3*	*Pin 3-4*	*+15VDC*	*+14.5¸ +15.5*
Temperature contr. pcb	*CN2/CN3*	*Pin 4-5*	*-15VDC*	*-14.5¸ -15.5*
Driver Mother pcb	*CN16/CN17*	*Pin 1-4*	*+24VDC*	*+23.0¸ +25.0*
DC Power pcb	*CN5/CN6/CN7*	*Pin 1-4*	*+12VDC*	*+12.0¸ +14.0*

b. Measure the lamp voltage. Measurement should be done with system in Ready status on the lamp connector. Specifications of measurements are:

Item	Location	Nominal VDC	Range
Lamp voltage	*Lamp connector*	*+11.5VDC*	*+11.4¸ +11.6*

c. Check the sensitivity of the level sensor of the sample probe

d. Check the sensitivity of the level sensor of the reagent (R1 & R2 probes

e. Check the following voltages of the ISE Main pcb:

Location	Nominal VDC	Range
TP 12-13	*5.00VDC*	*4.8 to 5.2VDC*
TP 14-15	*24.0VDC*	*23.0 to 25.0VDC*
TP 19-15	*12VDC*	*11.1 to 15.6VDC*
TP 16-17	*15.0VDC*	*14.25 to 15.75VDC*
TP 18-17	*-15.0VDC*	*-14.25 to -15.75VDC*

2.2.7 Mechanical verifications

a. Check the mechanical alignment of the following modules:

- Cuvette tray module
- Photometer module

- Sample probe (chemistry) module
- Sample probe (ISE) module
- Reagent (R1 & R1) probe modules
- Reagent tray
- Stirrer module
- Washing station module

2.2.8 Fluidics verifications

a. Check carefully for leakage at the rear and inside the analyzer

b. Check for leakages at the sample, reagent and ISE syringes

c. Check for leakage at the vacuum system

d. Check the pure water pressure - value has to be 90KPa - adjust if required

e. Check the vacuum level - nominal value is

f. Check the drain line for proper draining

g. Check visually the water circulation into the incubator water bath

h. Check the filling level of the cuvettes during cuvette washing

2.2.9 Others verifications

a. Check the level revision of the instrument software program on EPROM. Upgrade to the last revision level

b. Check the temperature of the Reagent compartment

c. Check the operation of sample bar ode reading

d. Check the operation of the reagent bar code reader

e. Check the remote control system

2.2.10 Analytical verification

Analytical verifications should be carried as follows:

a. Measure Water Blnks

perform at least two water blank measurements, then check the mean value. At any wavelenght Mean should be:

MEAN: 0 to 250mAbs

Note: SD performance is not meaningful

b. Run reagent blank+calibration

Perform a reagent blank and calibration of the following tests:

Cholesterol, Albumine, Calcium, Total Protein, Iron, AST and GGT.

Check the results according to the specifications indicated in the checklist reported in page 19

c. Run ISE internal calibration

Repeat ISE internal calibrations until the calibration does not show any flag. At this step perform:

1. five ripetitions of internal calibration. CF should be always within the following ranges:

Na: 0.95 to 1.20

K: 0.95 to 1.20

Cl: 1.00 to 1.20

2. three more repetitions of internal calibration. Calibrator concentration should always be within the following ranges:

Na: 198 to 202 mmol/L

K: 7.9 to 8.1 mmol/L

Cl: 158 to 162 mmol/L

d. Run precision test (chemistry+ISE)

Fill 20 cups of Serum Control material, and perform a precision test of the following tests:

Cholesterol, Albumine, Calcium, Total Protein, Iron, AST, GGT and ISE (Na, K, Cl).

Check the results according to the specifications indicated in the checklist reported in page 19

2.2.11 Installation check list

The check list in the next pages should be photocopied and used as a reminder during the installation visit.

ILab600 system installation check list

Date	Instrumet model & S/N
Customer	Contact person
phone	FSE signature

Action	**Checked**
Environmental check-outs	
Room temperature	*O*
Electrical requirements	*O*
Water supply/drain rquirements	*O*
DMS interconnection	*O*
Instrumental check-outs	
Check instrument crate	*O*
Check packing list	*O*
Check that PCBs, connectors and tubing are securely fastened	*O*
Perform system interconnection	*O*
Check the integrity of all cuvettes of reaction tray	*O*
Install ISE reagent & detergent solutions	*O*
Check grounding	*O*
Check ILab voltage settings	*O*
Install the personal computer - Install Windows NT & ILab600 sostware program	*O*
SW program rev.....	

Perform the following DC voltage measurements:

Item	***Location***	***Measured VDC***	***Range***
Temperature contr. pcb	*CN2/CN3 Pin 1-2*		*+4.9 to+5.2*
Temperature contr. pcb	*CN2/CN3 Pin 3-4*		*+14.5 to+15.5*
Temperature contr. pcb	*CN2/CN3 Pin 4-5*		*-14.5 to-15.5*
Driver Mother pcb	*CN16/CN17Pin 1-4*		*+23.0 to+25.0*
DC Power pcb	*CN5/CN6/CN7 Pin 1-4*		*+12 to+14V*
Lamp voltage	*Lamp connector*		*+11.4¸+11.6*
ISE Main pcb	*TP 12-13*		*4.8 to 5.2VDC*
ISE Main pcb	*TP 14-15*		*23.0 to 25.0V*
ISE Main pcb	*TP 19-15*		*11.1 to 15.6V*
ISE Main pcb	*TP 16-17*		*14.25 to 15.75V*
ISE Main pcb	*TP 18-17*		*-14.25 to -15.75*

Perform the following mechanical verifications:	
a. Check the mechanical alignment of the following modules:	
- Reaction disk module	*O*
- Photometer module	*O*

Action	**Checked**
- Sample probe (chemistry) module	*O*
- Sample probe (ISE) module	*O*
- Reagent (R1 & R1) probe modules	*O*
- Reagent tray	*O*
- Stirrer module	*O*
- Washing station module	*O*
Perform the following fluidics checks:	
a. Check carefully for leakage at the rear and inside the analyzer	*O*
b. Check for leakages at the sample, reagent and ISE syringes	*O*
c. Check for leakage at the vacuum system	*O*
d. Check the pure water pressure - value has to be 90KPa - adjust if required	*O*
e. Check the vacuum level - nominal value is -0.05 to -0.08 MP	*O*
f. Check the drain line for proper draining	*O*
g. Check for proper drain the pure water tank	*O*
h. Check for proper drain the incubator bath	*O*
i. Check visually the water circulation into the incubator water bath	*O*
l. Check the filling level of the cuvettes during cuvette washing	*O*
m. Check the adjustment of sample, R1 and R2 probes liquid sensors	*O*
n. Set the lower limit of sample, R1, R2 and ISE probes	*O*
Other verifications	
a. Check the level revision of the instrument software program on EPROM. Upgrade to the last revision level	*O*
b. Check the temperature of the Reagent compartment (Nominal 3 to 15°C)	*O*
c. Check the operation of sample bar code reading	*O*
d. Check the operation of the reagent bar code reader	*O*
e. Check the remote control system	*O*

Analytical verifications:

a. Measure Water Blnks:

MEAN value: _____mAbs (-250 to -525mAbs)

b. Run reagent blank+calibration

Test	*RGT blk mAbs*	*(spec)*	*CalmAbs*	*(spec)*	*Cal K1*	*(spec)*
Cholesterol	_____	*(N.A.)*	_____	*(N.A.)*	_____	*(N.A.)*
Albumine	_____	*(N.A.)*	_____	*(N.A.)*	_____	*(N.A.)*
Calcium	_____	*(N.A.)*	_____	*(N.A.)*	_____	*(N.A.)*
Total Protein	_____	*(N.A.)*	_____	*(N.A.)*	_____	*(N.A.)*
Iron	_____	*(N.A.)*	_____	*(N.A.)*	_____	*(N.A.)*
AST	_____	*(N.A.)*	_____	*(N.A.)*	_____	*(N.A.)*
GGT	_____	*(N.A.)*	_____	*(N.A.)*	_____	*(N.A.)*

c. Run ISE internal calibration

1. five ripetitions of internal calibration. CF should be always within the following ranges:

Na:	*0.95 to 1.20*	*1* _____	*2*_____	*3*_____	*4*_____	*5*_____
K:	*0.95 to 1.20*	*1* _____	*2*_____	*3*_____	*4*_____	*5*_____
Cl:	*1.00 to 1.20*	*1* _____	*2*_____	*3*_____	*4*_____	*5*_____

2. three more repetitions of internal calibration. Calibrator concentration should always be within the following ranges:

Na:	*198 to 202 mmol/L*	*1* _____	*2*_____	*3*_____
K:	*7.9 to 8.1 mmol/L*	*1* _____	*2*_____	*3*_____
Cl:	*158 to 162 mmol/L*	*1* _____	*2*_____	*3*_____

d. Run precision test (chemistry+ISE)

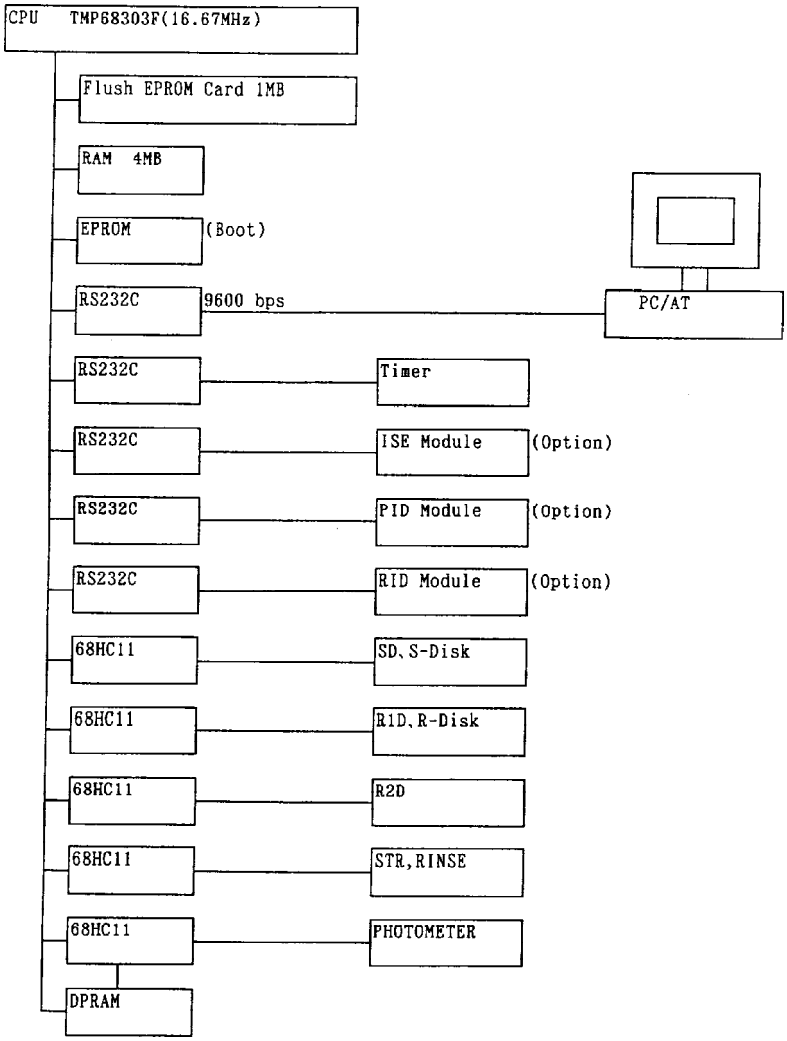
Test	*Concentration*	*(spec)*	*C.V*	*(spec)*
Cholesterol	_____	*(N.A.)*	_____	*(N.A.)*
Albumine	_____	*(N.A.)*	_____	*(N.A.)*
Calcium	_____	*(N.A.)*	_____	*(N.A.)*
Total Protein	_____	*(N.A.)*	_____	*(N.A.)*
Iron	_____	*(N.A.)*	_____	*(N.A.)*
AST	_____	*(N.A.)*	_____	*(N.A.)*
GGT	_____	*(N.A.)*	_____	*(N.A.)*
Na	_____	*(N.A.)*	_____	*(N.A.)*
K	_____	*(N.A.)*	_____	*(N.A.)*
Cl	_____	*(N.A.)*	_____	*(N.A.)*

3 Electronics

3.1 System description

3.1.1 Computer/Analyzer Block Diagram

Fig 3.1



3.1.2 Console SW structure

Figures 2, 3 and 4 below show block diagram of the ILab600 console SW structure

fig 3.2

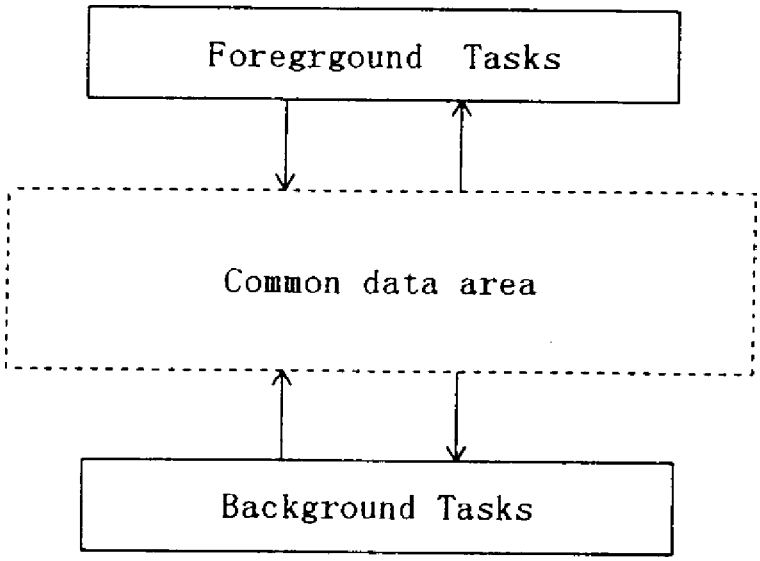


fig 3.3

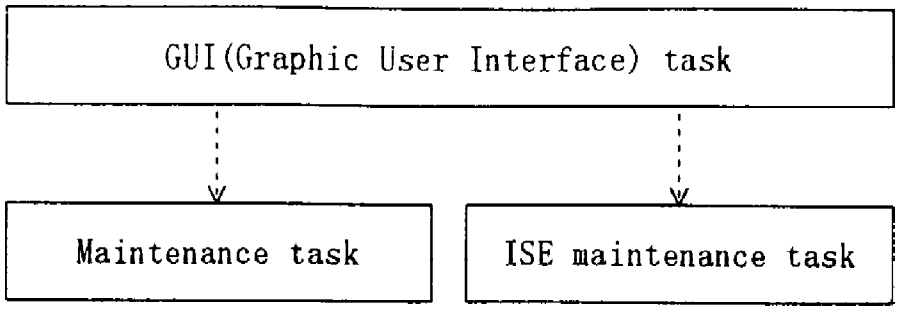
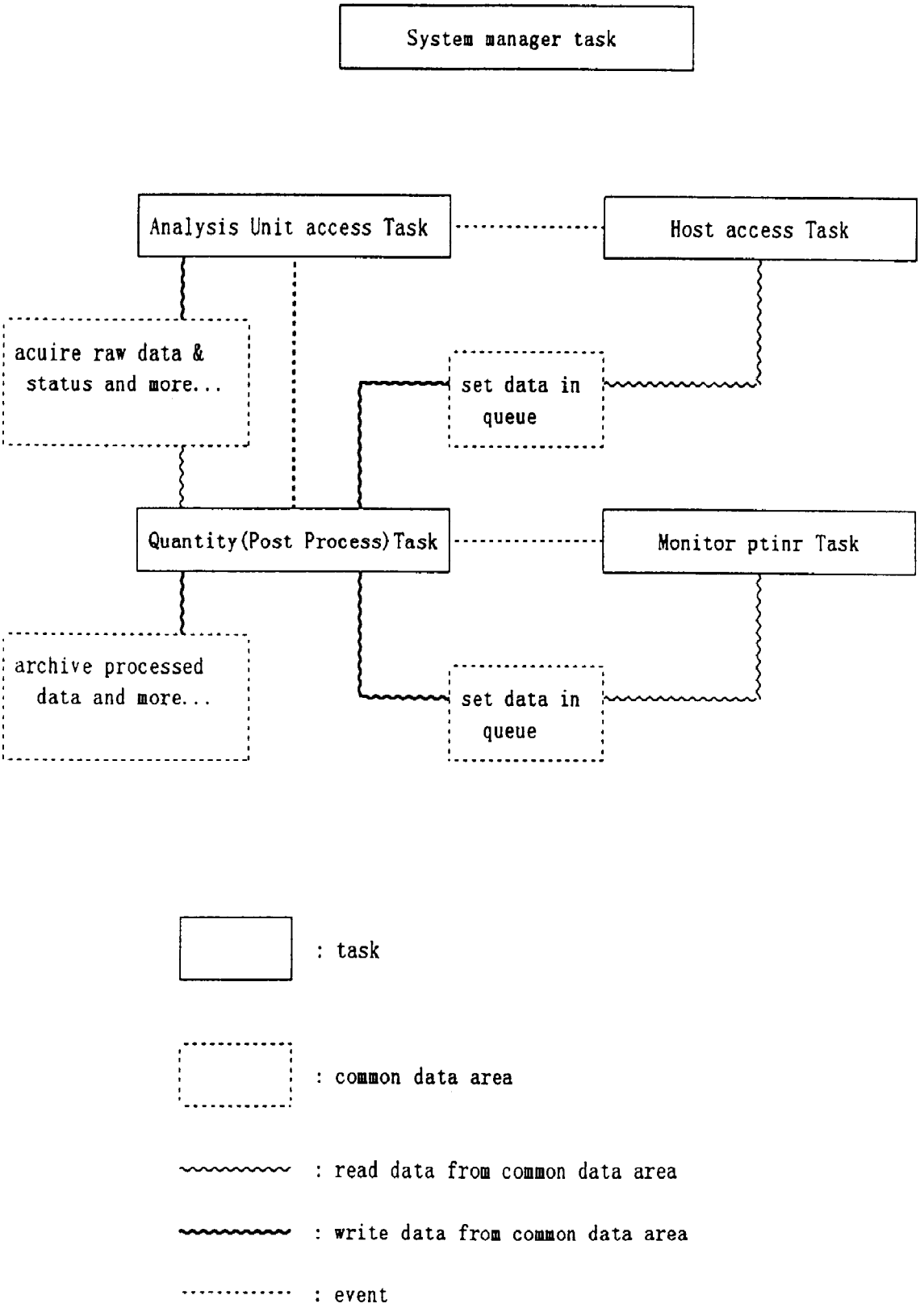


fig 3.4


System manager task
Analysis Unit access Task
Host access Task
acuire raw data & status and more...
set data in queue
Quantity(Post Process)Task
Monitor ptinr Task
archive processed data and more...
set data in queue
: task
: common data area
: read data from common data area
: write data from common data area
: event

3.1.3 Master CPU operation protocols

3.1.3.1 Operation protocol at system (power ON) (or reset)

STEP 1	*INITIAL OPERATION (TIME 0)* *1-Pure Water valve (SV71) is turned ON* **As Float Switch in PW Tank detects filled level low, PW Pump is turned ON* *2-Vacuum Pump is turned OFF* *3-Degasser Vacuum Pump is turned OFF* *4-Degasser Relief Valve (SV61) is turned ON for 15 sec.*
STEP 2	*2 SECONDS LATER* *1-Degasser Vacuum Pump is turned ON*
STEP 3	*35 SECONDS LATER* *1-Vacuum Pump is turned ON*
STEP 4	*40 SECONDS LATER *(AS PW PUMP IS TURNED ON)* *1-Photometer lamp is turned ON* *1 second after the Photometer lamp has been turned ON, the Light Source check is triggered* *2-Incubator Water Feed valve (SV34) is opened (turned ON)*
STEP 5	*AS INCUBATOR BATH LEVEL SENSOR IS ON FOR 1 SECOND* *1-Incubator Water Feed valve (SV34) is turned OFF* *2-Incubarot Circulating pump is turned ON* *3-Incubator Temperature regulation is turned ON*

3.1.3.2 Operation protocol at power saving mode (Sleep mode)

STEP 1	*SWITCH TO POWER SAVING MODE (SLEEP mode)* *1-Vacuum Pump is turned* *2-Degasser Vacuum pump is turned OFF* *3-Photometer lamp is turned OFF* *4-24VCD-A is turned OFF (vedere come)* *5-24VDC-B is turned OFF (vedere come)*

3.1.3.3 Operation protocol at emergency stop mode

STEP 1	*EMERGENCY SWITCHBUTTON IS PRESSED* *1-Incubator Drain valve (SV51) is turned OFF* *2-Incubator Water Feed valve (SV34) is turned OFF* *3-PW Tank Drain valve (SV72) is turned OFF* *4-PW Feed valve is turned OFF*

3.1.3.4 Operation protocol at standby mode

STEP1 *SWITCH TO STAND-BY MODE*

1-Incubator bath is controlled as follows:

-as Incubator Bath level sensor goes OFF (detecting low water level) the Incubator Water Feed valve (SV 34) is turned ON

-as Incubator Bath level sensor stays ON > 1 second the Incubator Water Feed valve (SV 34) is turned OFF

-as the cumulative opening time of Incubator Feed valve (SV34) reaches 40 seconds Detergent is automaticaly supplied into the incubator

-if the Incubator Bath level sensor is detecting water level low over 90 seconds while the Incubator Water Feed valve has been turned ON:

a-Incubator Water Feed valve is turned OFF

b-Incubator circulating pump is turned OFF

c-Incubator temperature regulation is turned OFF

d-Error condition is reported

2-Degasser Relief valve (SV61) is turned ON for 15 seconds every 15 minutes

3.1.3.5 Operation protocol of at analysis mode

DURING ANALYSIS THE INCUBATOR WATER LEVEL AND THE DEGASSER ARE CONTROLLED AS FOLLOWS:

1-the Incubator water feed valve is turned ON for 0.1 sec every 90 sec.

2-the Degasser Relief valve is turned ON for 15 seconds every 15 minutes

3.1.3.6 Opertion protocol at maintenance mode - water tank replacement

STEP 1 *WATER IN THE PURE WATER TANK IS DRAINED*

1-PW Pump is turned ON

2-PW Feed valve (SV34) is turned OFF

3-PW Tank drain valve (SV 72) is turned ON

STEP 2 *INTEGRITY CHECK OF THE OPERATION IS PERFORMED:*

Check 1: water level decrease in the PW tank is monitored as follows: Float Switch of PW Tank should detect low level of water (low level=Float Switch OFF) within 120 seconds. If not:

-error condition is reported and operation is interrupted

-Drain valve (SV72) is turned OFF

-Pure Water Feed valve (SV71) is turned ON
Check 2: Pure Water tank empty is checked as follows:
Pure water pressure switch should detect pressure low (Switch OFF) within 120 seconds after the Float Switch level OFF has been detected. If not:
- error condition is reported and the operation is interrupted
- Pure Water pump is turned OFF

STEP 3 *AS DRAINING OF WATER FROM PW TANK HAS BEEN COMPLETED (PRESSURE SWITCH TURNED TO OFF) RINSE OF PIPING IS PERFORMED BY FEEDING AND DRAINING A SMALL VOLUME OF WATER AS FOLLOWS:*
1-Pure Water pump is turned OFF
2-Pure Water Drain valve (SV72) is turned OFF
3-Pure Water Feed valve (SV71) is turned ON for 10 seconds

STEP 4 *WATER IS DRAINED REPEATING OPERATION DESCRIBED IN STEPS 1 AND 2 ABOVE*

STEP 5 *PURE WATER TANK IS REFILLED AS FOLLOWS:*
1-Pure Water pump is turned OFF
Pure Water Feed valve (VS71) is turned ON

STEP 6 *INTEGRITY CHECK OF THE OPERATION IS PERFORMED MONITORING THE FLOAT SWITCH OF PW TANK: the float switch should turn to ON within 10 minutes from starting of step 5. If not:*
1-Pure Water Feed valve (SV71) is turned OFF
2-error condition is reported and the operation is interrupted

---

3.1.3.7 Operation protocol at maintenance mode-incubator water replacement

---

STEP 1 *INCUBATOR WATER DRAINING STARTS*
1-Incubator Water Feed valve (SV34) is turned OFF
2-Incubator temperature regulation is turned OFF
3-Incubator Circulating pump is turned OFF
4-Incubator Drain valve (SV51) is turned ON

STEP 2 *INCUBATOR WATER IS DRAINED: water is drained for 30 seconds*

STEP 3 *WATER DRAINING IS STOPPED, WATER REFILL IS STARTED*
1-Incubator Drain valve (SV51) is turned OFF
2-Incubator Water Feed (SV34) valve is turned ON

STEP 4 *DETERGENT IS DISPENSED IN THE INCUBATOR*

1-Detergent is dispensed into the incubator by R2 dispenser. If no detergent is present error condition is reported and the operation is interrupted

STEP 5 *INTEGRITY CHECK OF OPERATION REFILL ES PERFORMED:*

Check: Incubator Bath level sensor should detect incubator full level (sensor turned to ON) within 90 seconds from starting step 3. If not:

1-Incubator Water Feed valve (SV34) is turned OFF

2-error condition is reported and the operation is interrupted

STEP 6 *INCUBATOR REFILL IS COMPLETED*

As the Incubator Bath level sensor has detected incubator level full (ref step 5):

1-Incubator Water Feed valve (SV34) is turned ON

2-Incubator circulating pump is turned ON

3-Incubator temperature regulation is turned ON

3.1.3.8 Operation protocol at maintenance mode - probe rinse with detergent

DESCRIPTION:THE DETERGENT IS ASPIRATED FROM THE SPECIFIED POSITION, THAN IT IS DISCARDED INTO THE RINSING POT

3.1.3.9 Operation protocol at maintenance mode - stirrer rinse with detergent

DESCRIPTION:THE SPECIFIED DETERGENT IS DISPENSED INTO THE CUVETTE BY THE R2 DISPENSER AND THE STIRRING PADDLE IS REINSED INSIDE THE CUVETTE as follows:

1-if the cuvette to be used is already rinsed, the water is drained. If the cuvette has not been rinsed yet, it is first rinsed with detergent

2-the specified detergent is dispensed into the cuvette to be used by R2 dispenser

3-the stirring paddle is moved down into the cuvette in which the detergente has been dispensed, then rotated

4-the stirring paddle is moved into the rinsing pot and rinsed by pure water

5-above steps 2 and 3 are repeated as many times as required

5-the cuvette used is rinsed with detergent

3.1.3.10 Operation protocol at maintenance mode - rinsing cells

1-Pure water+the specified detergent are loaded into probe of the wasing station
2-the cuvette under the washing station is rinsed
3-the cuvette tray is rotated by one cuvette
4-the above steps 2 and 3 are repeated untill all cuvettes have been rinsed by all the 6 probes of the washing station
5-Pure water is loaded into the probe of the washing station
6-cuvette is rinsed by pure water 5 times
7-cuvette is drained

3.1.3.11 Operation integrity check monitoring sensors status

1-as all the cuvettes have been rinsed, water is drained. If any cuvette has not been rinsed yet, cuvette washing with detergent is performed
2-pure water is loaded into the rinsing probe
3-pure water is loaded into the cuvette using rinsing probes #3,4,5
4-Cuvette tray is rotated in order to place cuvette # 1 at the beginning of photometry acquisition position
5-data acquisition is performed for 81 cuvettes

3.1.3.11 Operation integrity check monitoring sensors status

Error condition: -An error condition is triggered whenever the sensor status is turned to OFF continuously for the timing indicated in table below:

Sensor	Timing
Pure water level low signal	5 seconds
Pure water pressure switch	5 seconds
Degasser chamber pressure switch	5 seconds
Vacuum tank level switch	5 seconds
Vacuum tank pressure switch	18 seconds
Drain tank full	5 seconds
Incubator water level detection	1 second
Other error condition signals	1.5 seconds

Normal condition:-The normal condition status is triggered whenever the status of any sensor is turned ON continuosly for 1 second.

3.1.4 Slave CPU Control

3.1.4.1 General description of Slave CPU control

Configuration

The ILab600 system is equipped by two Slave CPUs CPU SLA-VE A and cpu slave b) located into the Controller Cardcage.

Each slave CPU is a 68 Series 8-bit one-chip microcomputer; the control program is stored in a CMOS 32kB EPROM.

Job management

The Main CPU manages the job of the entire Analyzing unit.

The Slave CPUs manage the job of each module (i.e. motor drive, etc). The system is divided into the modules indicated below, and each module is controlled by a dedicated CPU: (the abbreviation of the CPU name is indicated on the PCB.

Sample dispenser/sample tray:	SDC (sample dispenser control)
R1 dispenser/reagent disk:	R1DC (R1 dispenser control)
R2 dispenser/sample cup stirrer:	R2DC (R2 dispenser control)
Stirrer/rinsing module:	SRC (stirrer rinse control)
Photometer/reaction disk:	PHC (photometer control)

Slave CPU execution format

The analysis operation program of the Slave CPU is stored in the ROM of the Slave CPU and the ROM card of the Main CPU. Whenever the power is turned ON the two ROMs programs are compared, and the newer version program is downloaded into the RAM of the Slave CPU. The program downloaded in the RAM of the Slave CPU will be executed.

Communication between Main CPU and Slave CPUs

On analysis operation the Main CPU manages the entire Analyzing module sending commands to each Slave CPU. The Slave CPU performs the specified operations, and returns the knowledges on status information if required. While a command execution is in progress, no other command except Emergency Stop is accepted.

Communication between Slave CPUs A and B

Specific checks are run between Slave CPUs in order to prevent any conflict between mechanical operations.

3.1.4.2 Operation description at system power ON

STEP 1 *As power is turned ON, all the Slave CPUs start the common downloading program. The program is started up in the ROM of the Slave CPU, and enables the Slave CPU to communicate with the Main CPU.*

Note: at this step mechanical module are still not operating yet

STEP 2 *The system compares the level revision of the program resident in the ROM of the Slave CPU versus the level revision of the program resident in the Main CPU, then, if the Main CPU ROM has an higher revision level, program is downloaded into the RAM memory of the Slave CPUs. If the Main CPU ROM and the Slave CPU ROM have the same revision level, program is downloaded from the Slave CPU ROM into the RAM. Downloading time is much shorter if program is downloaded from the Slave CPU ROM.*
As program download is completed mechanical reset is performed

3.1.4.3 Operation description at Emergency Stop

STEP 1 *EMERGENCY STOP PUSHBUTTON IS PRESSED*
1-each Slave CPU stops immediately its operation. All arms are immediately moved to the position UP (in order to prevent any conflict with rotation of sample, reagent and cuvette trays)
2-LED are flashing. If an error is detected, error code is reported by LEDs.
Note: in Emergency Stop status, the Slave CPUs accept only Reset Instructions

3.1.4.4 Operation description at system reset

STEP 1 *SYSTEM RESET*
1-at Reset all mechanical modure are initialized

3.1.4.5 Operation description at system routine analysis

All operations of the ILab600 analyzer system are performed within a timing cycle of 9 seconds (system cycle). After a routine analysis cycle has been started, each CPU performs its tasks following the specific timing indicated below:

Slave CPU	Timing (start time delay)
Photometer/cuvette tray	0.0 sec
Sample dispencer/sample tray	0.2 sec
R1 dispenser/reagent tray	2.6 sec
R2 dispenser/sample cup stirrer	7.0 sec
Stirrer/washing station	12.0 sec

Note: the Stirrer/washing station operation starts only during the second System Cycle.
The system checks that all mechanical operations are properly performed within the specific timing. Should any error or delay condition be detected, it will trigger a specific time-out error.

3.1.4.6 Operation description of Sample Dispenser

TASKS

The sample dispenser CPU and ROM control the following items:
1-Sample probe module (probe up/down motor and probe rotation motor)
2-Sample syringe module (syringe up/down motor)
3-Sample tray (sample tray rotation motor)
4-Probe internal and external rinsing valves
5-Liquid level sensor of sample probe (capacitive)
6-PID bar code reader

Operation cycles

The sample dispenser CPU controls the followin operation cycles:
1-the sample probe detects the sample level (in the cup/tube) by using the liquid level sensor
2-the sample probe aspirates the required volume of sample from the cup/tube into the sample tray or from the cuvette (diluted sample) and dispense it into the cuvette
3-the sample dispenser generates the PID bar code read start signal. The Data will be maneged by the Main CPU
4-the sample probe level sensor detects the remaining volume of sample to be used for the ISE analysis
5-the operative vertical mechanical travel of the sample probe is managed by the sample dispenser, by measuring the distance (in steps) between the probe up position and the bottom of sample cup/ tube
6-the sample probe rinse with detergent

Ranges

The ranges of the items controlled by the sample dispenser are the following:
1-the sample syringe can mechanically aspirate 64ul maximum of sample. The max volume is reduced to 60ul by the ROM control
2-the sample tray is divided in position No 1 to 30 on tray outer, 31 to 60 on tray middle and 61 to 75 on tray inner. Only positions No 1 to 60 are available for PID, R1 probe and sample stirrer module
3-sample dispenser can manage: standard cups, micro cups, primary tubes, standard cups placed into primary tubes and micro cups placed into primary tubes
4-sample probe can rotate to six positions pre-defined (cuvette, rinsing pot, detergent, outer middle and inner sample tray)

3.1.4.7 Operation description of R1 Dispenser

TASKS

The R1 dispenser CPU and ROM control the following items:
1-R1 probe module (probe up/down motor and probe rotation motor)
2-R1 syringe module (syringe up/down motor)
3-Reagent tray (reagent tray rotation motor)
4-R1 probe internal and external rinsing valves
5-Liquid level sensor of R1 probe (capacitive)
6-RID bar code reader

Operation cycles

The R1 dispenser CPU controls the followin operation cycles:
1-the R1 probe detects the sample level (in the cup/tube) by using the liquid level sensor
2-the R1 probe aspirates the required volume of reagent from the bottle into the reagent tray or from and dispense it into the cuvette
3-the R1 dispenser generates the RID bar code read start signal. The Data will be maneged by the Main CPU
4-the operative vertical mechanical travel of the R1 probe is managed by the R1 dispenser, by measuring the distance (in steps) between the probe up position and the bottom of reagent bottles (100ml and 20ml)
5-the R1 probe dispense reagent for dilution with sample into the sample cup in sample tray
6-performs R1 probe rinse with detergent

Ranges

The ranges of the items controlled by the R1 dispenser are the following:
1-the R1 syringe can mechanically aspirate 660ul maximum of reagent. The max volume is reduced to 600ul by the ROM control
2-the reagent tray is divided in position No 1 to 32 on tray outer and 32 to 64 on tray inner. The same control is also available for R2 dispenser
3-R1 dispenser can manage standard bottles of 20 and 100ml
4-R1 probe can rotate to eight positions pre-defined (cuvette, rinsing pot, detergent 1, detergent 2, outer and inner reagent tray, middle of sample tray)

3.1.4.8 Operation description of R2 Dispenser and SPL Stirrer

TASKS

The R2 dispenser and sample stirrer CPU and ROM control the following items:

1-R2 probe module (probe up/down motor and probe rotation motor)
2-R2 syringe module (syringe up/down motor)
3-sample stirrer (stirrer up/down motor)
4-stirrer paddle spinning (DC motor)
5-R2 probe internal and external rinsing valves
6-Liquid level sensor of R2 probe (capacitive)

Operation cycles

The R2 dispenser and sample stirrer CPU controls the following operation cycles:

1-the R2 probe detects the sample level (in the cup/tube) by using the liquid level sensor
2-the R2 probe aspirates the required volume of reagent from the bottle of the reagent tray or from and dispense it into the cuvette
3-the R2 dispenser performs dilution dispensing (dispenses both degassed water and reagent simultaneously into the cuvette)
4-the operative vertical mechanical travel of the R2 probe is managed by the R2 dispenser, by measuring the distance (in steps) between the probe up position and the bottom of reagent bottles (100ml and 20ml)
5-the R2 dispenser dispenses detergent into the incubator
6-the R2 dispenser performs R2 probe rinse with detergent
7-sample stirrer mix sample inside sample tray cup during sample dilution
8-performs stirrer paddle rinse with detergent

Ranges

The ranges of the items controlled by the R2 dispenser and sample stirrer CPU are the following:

1-the R2 syringe can mechanically aspirate 660ul maximum of reagent. The max volume is reduced to 600ul by the ROM control
2-R2 dispenser can manage standard bottles of 20 and 100ml
3-R2 probe can rotate to ten positions pre-defined (detergent for incubator, cuvette, incubator, rinsing pot, detergent 1, detergent 2, outer and inner reagent tray, middle of sample tray)
4-the sample stirrer can rotate to four positions pre-defined (rinsing pot, detergent, outer and middle sample tray)

3.1.4.9 Operation description of the Stirrer/Rinse

TASKS

The Stirrer/Rinsing CPU and ROM control the following items:

1-Items related to the internal rinsing of the cuvettes (wash station)

- *a-washing station up/down motor*
- *b-control of cuvette rinse feed valves SV31 to SV33*
- *c-control of cuvette rinse feed valves SV42 to SV44*
- *d-control of cuvette rinse feed valves SV81 to SV86*

2-Items related to the internal rinsing of the cuvettes (stirrer module)

- *a-stirrer arm (up/down motor, rotation motor)*
- *b-spinning of stirrer paddles 1 and 2*
- *c-control of stirrer rinse pot (SV24)*
- *d-monitoring of power errors (failure of fuses FS7, FS10)*

Valve Details

(NC)=Normally Close (NO)=Normally Open

SV24(NC)	*feed valve of stirrer rinse pot*
SV31(NC)	*feed valve of washing probes 1&2 (detergent 1&2)*
SV32(NC)	*feed valve of washing probes 3 to 5 (pure water)*
SV33(NC)	*feed valve of washing probe 6 (tip)*
SV42(NO)	*depressurizing vacuum pot fluidics*
SV43(NO)	*for discarding secondary drain from vacuum pot*
SV44(NO)	*for discarding primary drain (biological)*
SV81(NC)	*detergent 1 extrusion valve*
SV82(NC)	*detergent 1 supply valve*
SV83(NC)	*detergent 1 charge valve*
SV84(NC)	*detergent 2 extrusion valve*
SV85(NC)	*detergent 2 supply valve*
SV86(NC)	*detergent 2 charge valve*

Operation cycles

The R2 stirrer/rinse CPU controls the following operation cycles:

1-washing station: the washing station operates vertical actuation between the following positions:

- *a-upper position (home position, detected by a specific sensor)*
- *b-cuvette port (to dispense water into cuvettes)*
- *c-cuvette 2/3 position (to perform rinse with water when detergent is dispensed*
- *d-lower limit (detected by a specific sensor)*

2-stirrer module: incudes two stepper motors: for horizontal rotation and for vertical up/down actuation and two photosensor. Operating positions of the stirrer module are the following:

- *a- rotational operating:*
  - *-rinsing pot: is the home position (detected by encoder)*
  - *-cuvette: detected by encoder*
- *b-vertical operating:*
  - *-upper position: is the home position (detected by sensor)*
  - *-lower position for rinsing into the rinsing pot*
  - *-lower position for stirring 6mm over the lower limit*
  - *-lower limit*

3.1.4.10 Operation description of the Photometer/Cuvette Tray

TASKS	*The Photometer CPU and ROM control the following items:* *1-driving the cuvette tray* *2-acquisition of the photometry data* *3-monitoring the light source error* *4-monitoring the power error (fuse FS6)*
Specifications	*-16-bit A/D converter enables photometry of 12 wavelenghts (12channels)* *-one cycle is performed in 9 seconds* *-one complete revolution of the cuvette tray is performed in 2 cycles (18 seconds)* *-photometry of 40+1 cuvettes is performed in one cycle* *-on each photometry cycle the system takes 144 data readings (12 wavelenghts per 12 times) for each cuvette* *-on every cycle 1 Data Point is calculated for each wavelength per cuvette. Data Point is the mean value of the lower 8 readings* *-Data Point value is sent to the consolle computer by the Main CPU, and it is managed as 1 data point of the reaction curve*

Flow Description		
	a-15VDC power supply	*electronics*
	b-Light source	*electronics/electrics*
	c-Photometry items	*mechanical*
	d-Detector (photo diode array)	*electronics*
	e-AMP pcb (log amp, A/D converter)	*electronics*
	f-Slave B CPU (A/D conv, register, CPU)	*electronics*
	g-Photometry control ROM (photometry,selection, calculation of mean val,saved in DPRAM)	*electronics*
	h-Main CPU pcb (DPRAM, RS232C)	*electronics*
	i-consolle PC (RS232C, creation of graph, etc)	*electronics*

3.1.4.11 Operation description of Liquid Level Detection function

Operation Cycle ***Description of sensor reading***

a-one sensor electrostatic capacity type is used for detecting the liquid level

b-during liquid level detection cycle the program takes a 16 bits reading; among the 16 bits readig, 8 bits are selected and managed as 1 Data Reading. The 8 bits are selected with the following criteria:

Bit # I 16 I 15 I 14 I 13 I 12 I 11 I 10 I 9 I 8 I 7 I 6 I 5 I 4 I 3 I 2 I 1 I

These 8 bites are selected as Data Reading

Operation Cycle ***Description of the liquid level detection subroutine cycles (refer to flow chart:***

1-electrostatic capacity reading (reference value)

reference value to be used as base line is calculated as follows: the sensor electrostatic capacity is detected 10 times (with sensor in air). The central (MEDIAN) value of the 10 data is considered the reference value

2-electrostatic capacity reading (current value)

current value to be used for evaluationg the presence of liquid is calculated as follows:

the system starts reading the sensor capacity. the oldest of the 10 readings performed during the reference value reading is erased and replaced by the current value data, and the new average value is calculated.

3-difference calculation (variation)

system performs the following calculation:

Variation = Current Value - Reference Value

As variation value reaches the set limits, liquid detection status is triggered to YES. The variation value depends on the vertical position of the probe, and is set as per values indicated in table 1 in next pages.

4-check "is probe above the upper edge of the cup?"

this is a further check performed after liquid detection is triggered to YES. If presence of liquid is detected within an area that is calculated to be over the upper edge of the cup, error condition is triggered and warning is reported.

5-check "has the probe reached low limit?"

if the probe reaches the low limit without detecting liquid presence, a warning "sample/reagent short" is triggered

Fig 3.5 Flow chart Liquid level detection flow chart

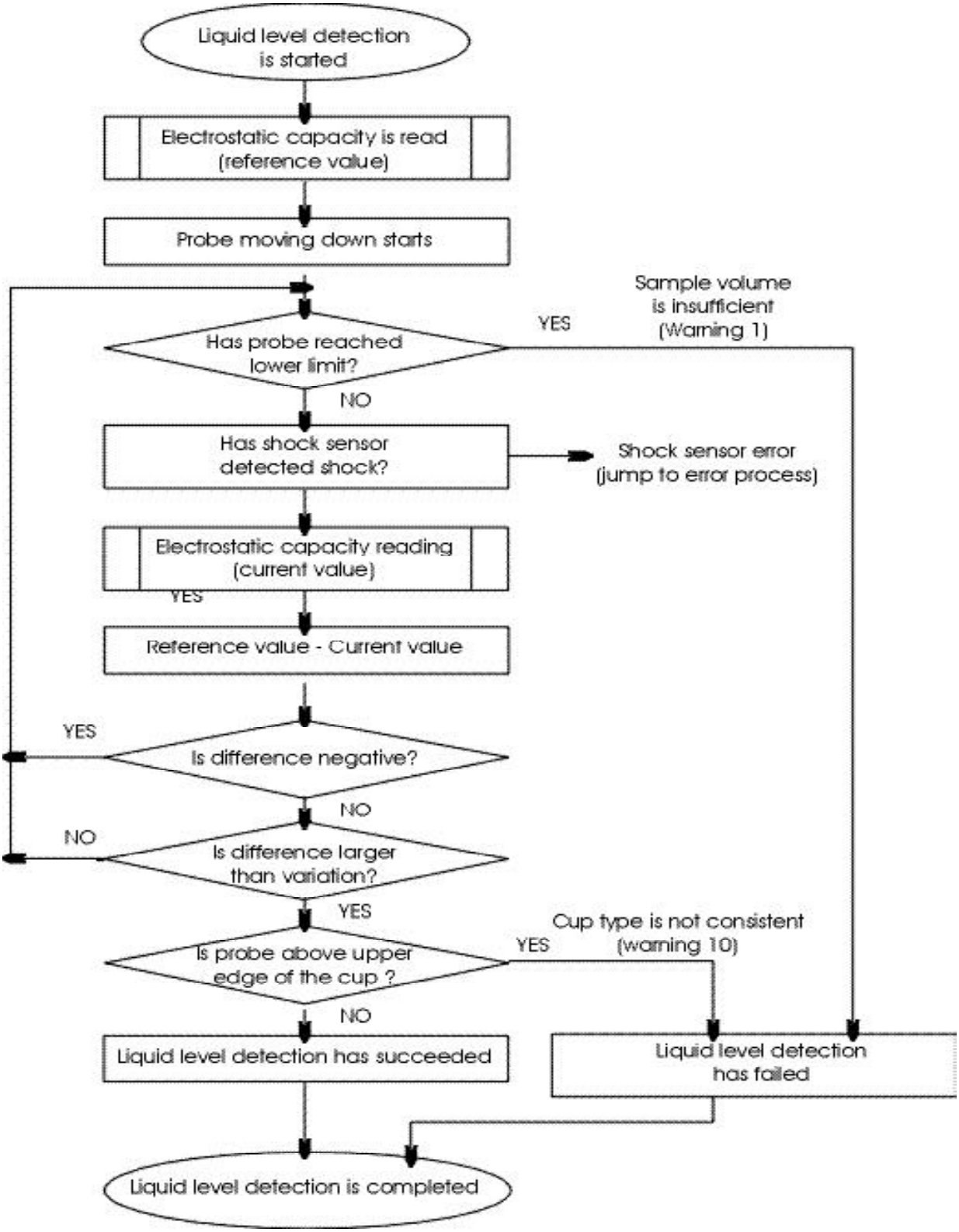


TABLE 1 *Values of Variation of sample and reagent probes on the different conditions*

1 - Standard cup	
distance from sample level to lower limit	Variation value
34.95mm or higher	6
from 27.45 to 34.95mm	8
from 12.45 to 27.45mm	6
12.45mm or lower	6
2 - Micro cup	
distance from sample level to lower limit	Variation value
35.25mm or higher	6
from 30 to 35.25mm	8
from 20.1 to 30mm	6
20.1mm or lower	6
3 - Primary tube	
distance from sample level to lower limit	Variation value
99mm or higher	6
from 66 to 99mm	10
from 33 to 66mm	8
33mm or lower	6
4 - Standard cup inside tube	
distance from sample level to lower limit	Variation value
34.95mm or higher	6
from 27.45 to 34.95mm	8
from 12.45 to 27.45mm	6
12.45mm or lower	6
5 - Micro cup inside tube	
distance from sample level to lower limit	Variation value
35.25mm or higher	6
from 30 to 35.25mm	8
from 20.1 to 30mm	6
20.1mm or lower	6

6 - 20ml standard bottle and 20 ml special bottle	
distance from reagent level to lower limit	Variation value
96.6mm or higher	99
from 64.35 to 96.6mm	12
from 32.25 to 64.35 mm	10
32.25mm or lower	8
7 - 100ml standard bottle and 100 ml special bottle	
distance from reagent level to lower limit	Variation value
97.95mm or higher	99
from 65.25 to 97.95mm	12
from 32.7 to 65.25 mm	10
32.7mm or lower	8

Operation Cycle

Description of speed control of probe-down operation during liquid level detection

the sample tray can manage the following models of sample cups: standard cup 3ml, micro cup, primary tubes (13x100, 16x100, 13x75, 16x74), standard cups placed into primary tube and micro cup placed into primary tube.
The reagent tray can manage 20ml and 100ml bottles
The control of the probe down speed is not the same for all the models of cups/bottles, but it has beem optimized as follows:

1 - Standard cup and micro cup

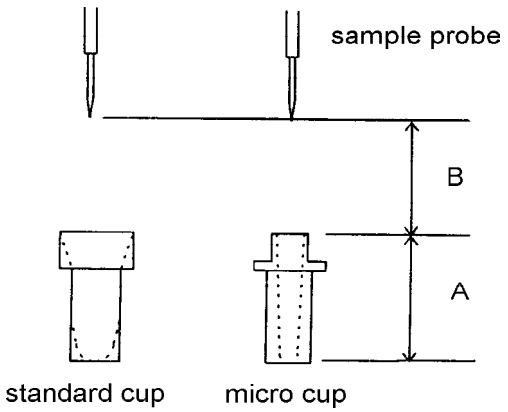


Figure 3.6 above shows diagram of sample probe travellig.
area B: sample probe is drived with accelerated/decelerated speed
initial speed=500pps
final speed=1250pps
total travel=330pulses
Note:if liquid level is detected in this area error is reported

area A: *sample probe is drived at constant speed*
speed=500pps
max travel=229pulses
Note:after liquid detection, probe is drived 4 more steps downward

---

2 - Primary tube

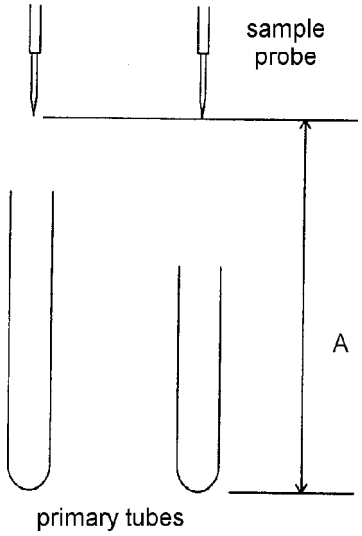


Figure 3.7 above shows diagram of sample probe travelling
Area A: *sample probe is driven with accelerated/decelerated speed*
initial speed=500pps
final speed=950pps
Note:after liquid detection, probe is drived 4 more steps downward
Note:if liquid level is detected over the top border of the tube an error is reported

---

3 - Standard cup and micro cup inside primary tube

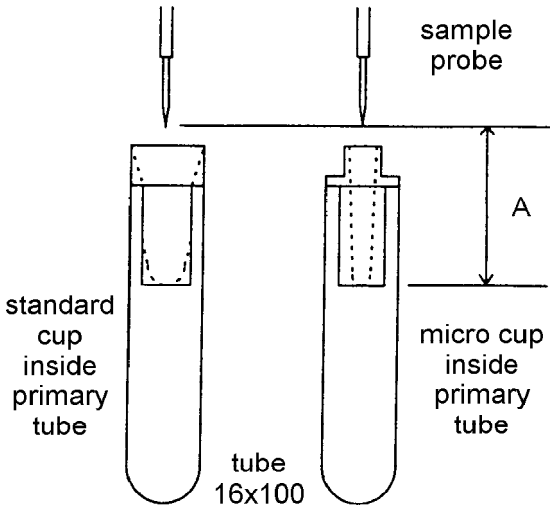


Figure 3.8 above shows diagram of sample probe travelling
Area A: sample probe is drived with constant speed
speed: 500pps
max travel: 293pulses
Note:after liquid detection, probe is driven 4 more steps downward
Note:if liquid level is detected over the top border of the cup an error is reported

4 - Reagent bottle

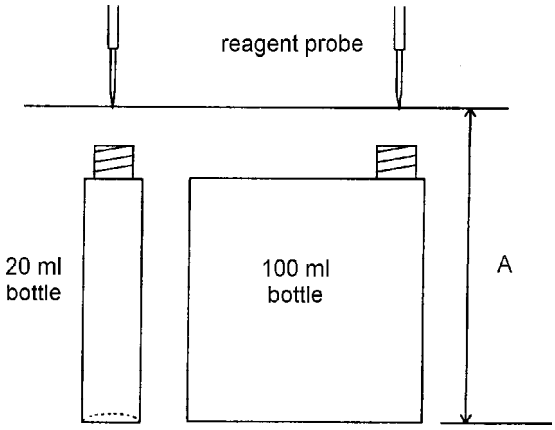


Figure 3.9 above shows diagram of reagent probe travelling
Area A: reagent probe is driven with accelerated/decelerated speed
initial speed=500pps
final speed=950pps
max travel=770pulses
Note:after liquid detection, probe is decelerate to a low speed of 500pps during a period of 5 to 12 pulses, then stopped
Note:if liquid level is detected over the top border of the bottle an error is reported

Operation Cycle

Description of the probe control after liquid level detection
As the probe sensor has detected the liquid level, the system starts liquid (sample or reagent) aspiration, and at the same time the probe is driven a few pulses downward, following the decrease of liquid into the cup/bottle. This cycle is called "Follow-Up Move Down" cycle (FUMD). The FUMD cycle is performed only when aspiration is performed in standard cup, micro cup, 20 and 100 ml bottles. No FUMD cycle is performed when sample aspiration is performed in tube. FUMD cycle specifications are the following:

1 - Standard cup

The number of pulses of FUMD cycle is set according to:
1:the sample volume required
2:the position of liquid level detection inside the cup

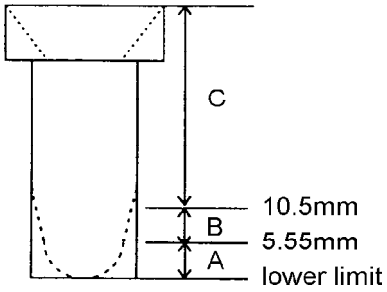


Figure 3.10 above shows the cup divided in 3 areas. The number of pulses of FUMD cycle is set as follows:

area of spl detection	sample vol req.(ul)	pulses
A	5 or less	2
A	from 6 to 10	6
A	from 11 to 20	10
A	from 21 to 40	14
A	41 or more	18
B	40 or less	6
B	41 or more	12
C	40 or less	0
C	41 or more	6

2 - Micro cup

The number of pulses of FUMD cycle is set according to:
1:the sample volume required
2:the position of liquid level detection inside the cup

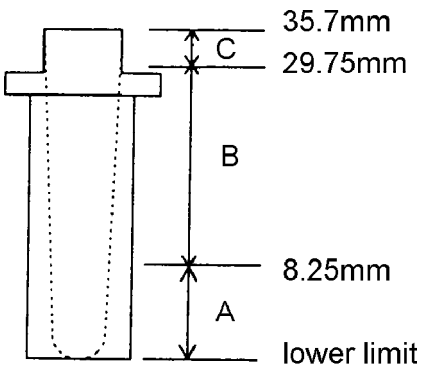


Figure 3.11 above shows the cup divided in 3 areas. The number of pulses of FUMD cycle is set as follows:

area of spl detection	sample vol req.(ul)	pulses
A	10 or less	3
A	from 11 to 20	8
A	from 21 to 30	13
A	from 31 to 40	16
A	41 or more	23
B	10 or less	0
B	from 11 to 20	3
B	from 21 to 30	6
B	from 31 to 40	10
B	41 or more	15
C	20 or less	0
C	21 or more	6

3 - Reagent bottle
The number of pulses of FUMD cycle for reagent aspiration is set as follows:
1-20ml bottle: 7 pulses
2-100ml bottle: 0 pulses

3.1.4.12 Operation description of the Timer

TASKS

The Timer assy performs the following tasks:
1-controls the power supply of the system by Solid State Relay
2-manages the system power switch and the power LED
3-tracks date and time

Specifications

the timer board is equipped by a ROM that is programmed to perform the following operations:
1-controls the timer that tracks the clock (year, month, day, hour, minute, second
2-monitors the status of the Main Power switch, and turns ON the system power according to the status of Main Power switch
3-saves the Timer schedule (sent from the Main CPU) and controls automatic start-up e shut-down
4-information on date and time and timer schedule are saved by battery backup power system, they are therefore saved also in the case of power failure

Operation Cycles

1-initialization of the Timer CPU at ILab power ON is performed as follows:

a-the ROM of the Timer CPU checks the the ID code, the SRAM and the timer.

b-if no error is detected the LED 2 (power interruption) is turned ON

c-if any corruption is detected the ROM clears the SRAM, sets the current date and time to 96-1-1 00:00:00 and clears startup schedule. LED 1 (initialization) is turned ON

2-inizialization of the Timer CPU at ILab Reset (by pressing the Reset switch) is performed as follows:

a-the ROM of the Timer CPU checks the timer.

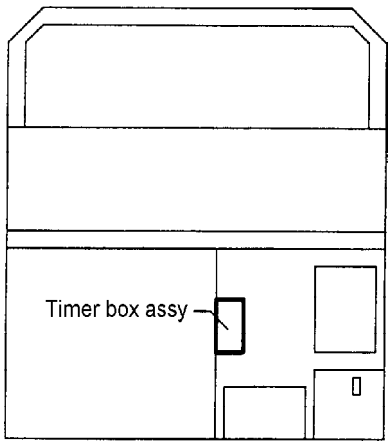
b-if no problem is detected the ROM clears the SRAM and the autostartup schedule. LED 2 (power interruption) is turned ON

c-If any problem is detected in the timer, the ROM clears the SRAM, set the current date and time to 96-1-1 00:00:00 and clears startup schedule. LED 1 (initialization) is turned ON

3.1.4.12.1 Location of the Timer Assy

The Timer assy can be accessed from the rear of the ILab600 system, as shown in figure below

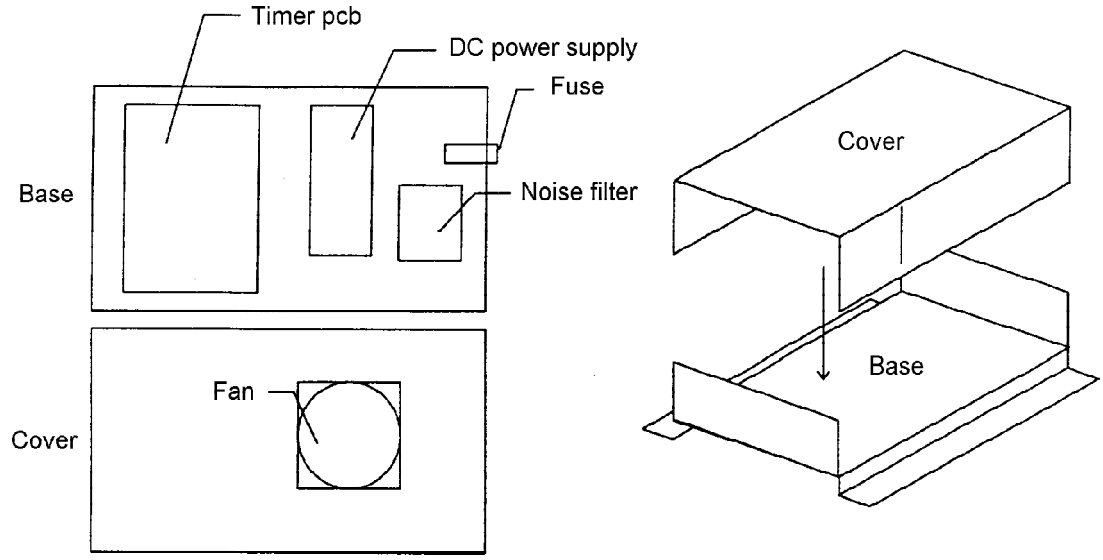
Figure 3.12 - Location of timer assy



The timer assy consists of the Timer board, the DC power supply, the noise filter, the fuse and the fan.

The Timer pcb is equipped by a microprocessor and a ROM.

Figure 3.13 - Timer assy



3.1.5 Drivers

Power drivers required for driving all the motors, solenoid valves and sensors of the ILab600 system are located in two specific PCBs:

1. Driver A pcb
2. Driver B pcb

Specific tasks of each pcb are highlighted by block diagrams in fig 3.8 and 3.8.

3.1.6 Temperature control

3.1.6.1 IncubatorTemperature

To be provided

3.1.6.2 Reagent compartment temperature

To be provided

3.1.7 DC Power distribution

Block diagrams of DC power distribution is reported in figure 3.10

Figure 3.14 - I/O Driver A interconnection diagram

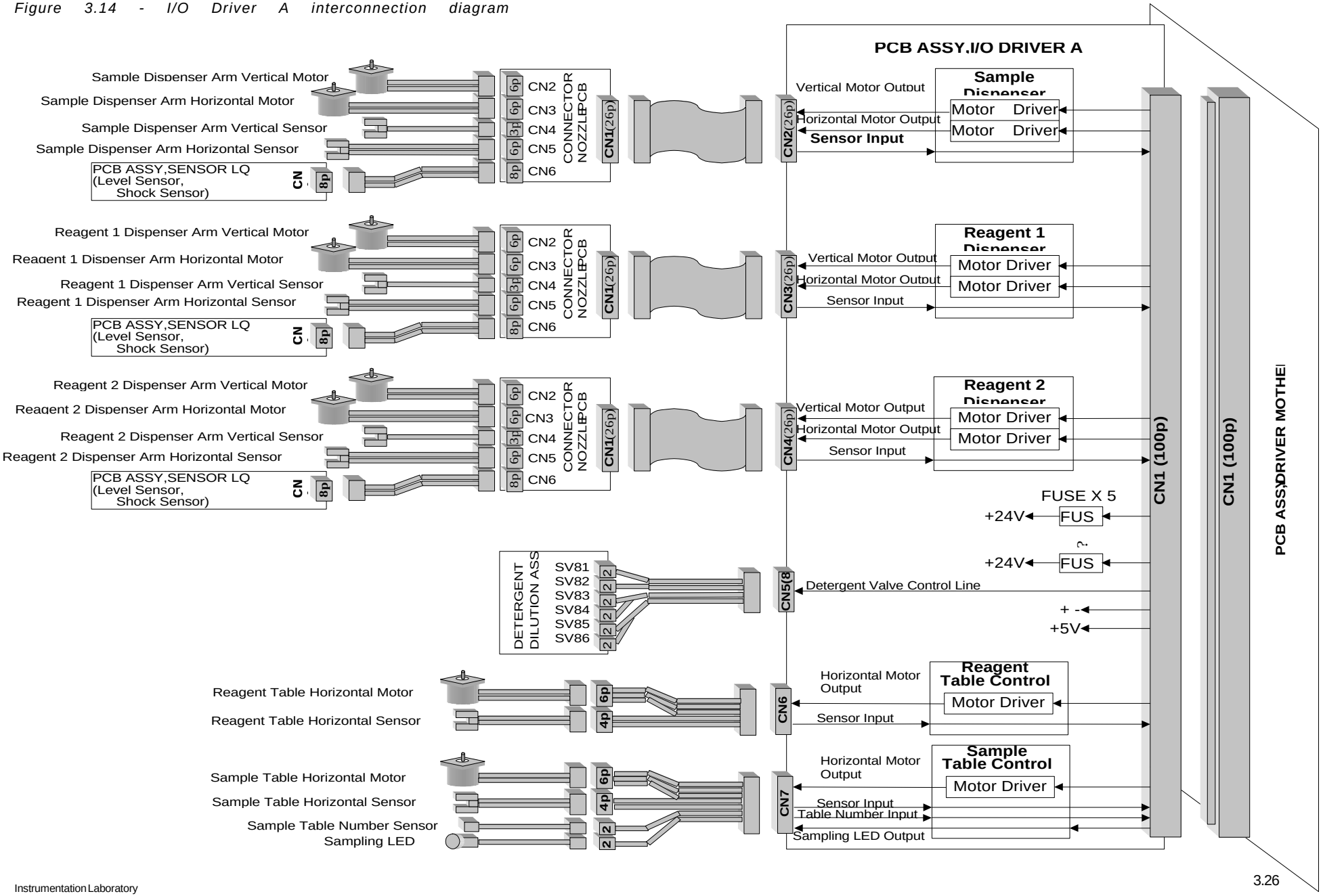


Figure 3.15 - I/O Driver B interconnection diagram

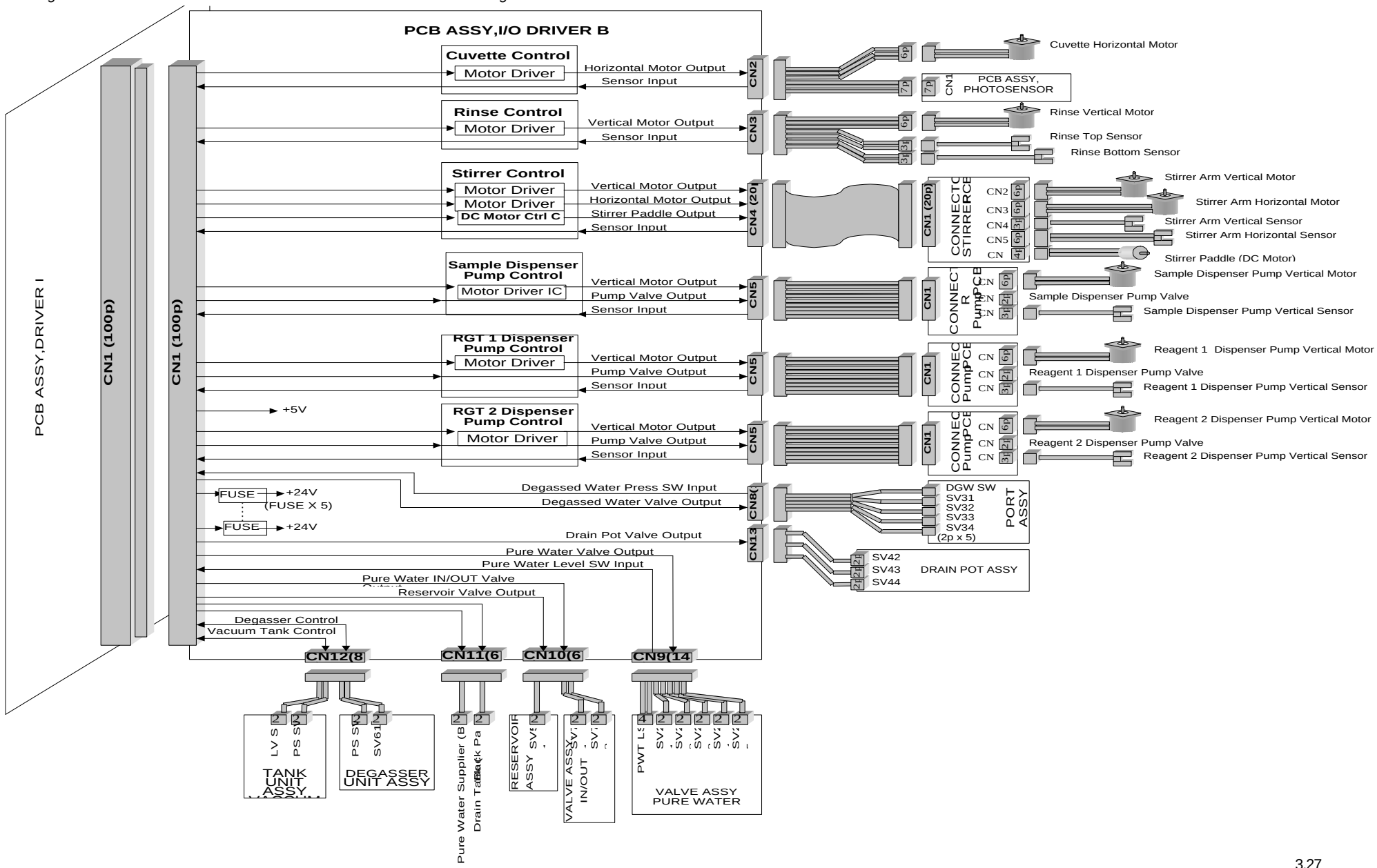
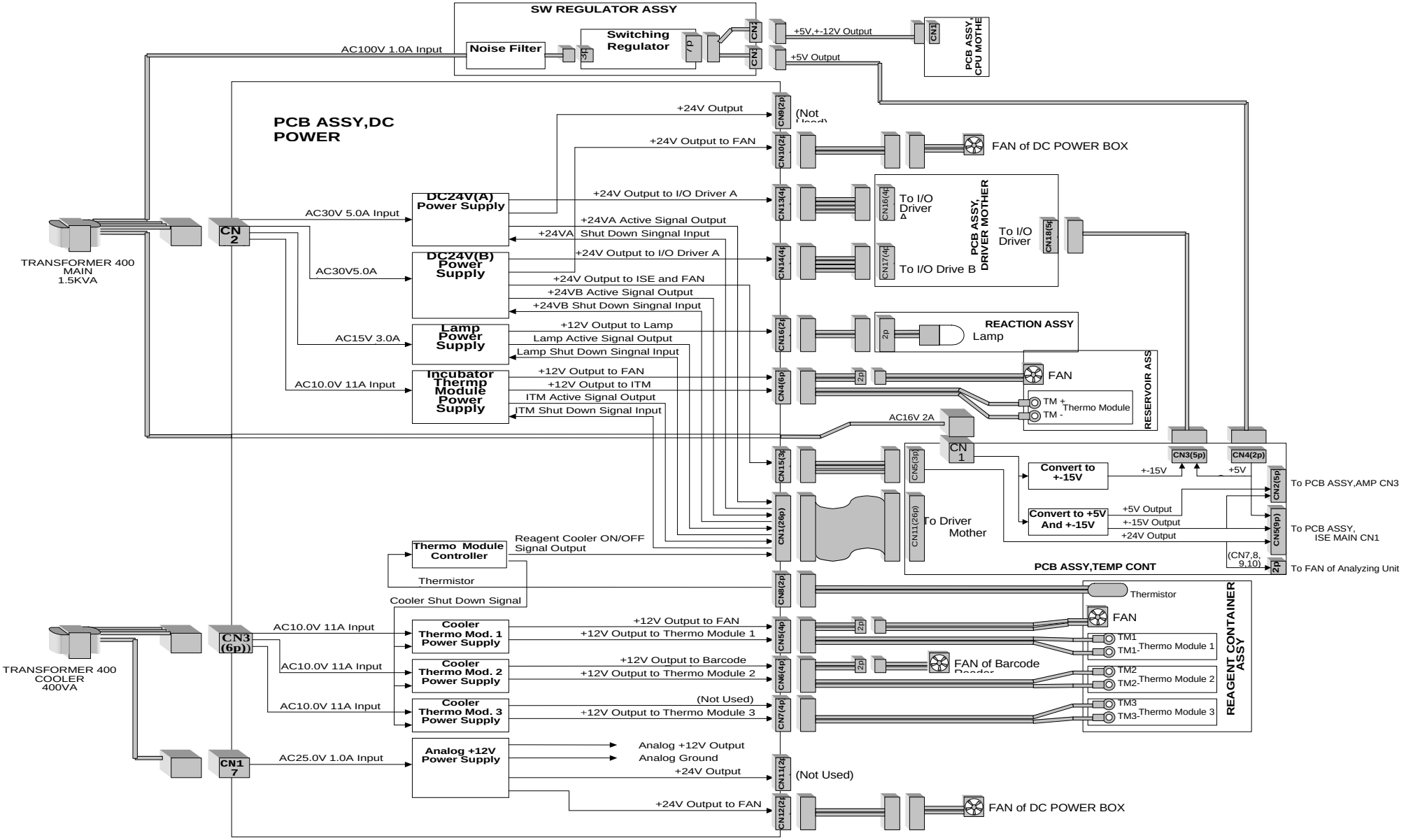


Figure 3.16 - DC Power interconnection



3.1.8 AC Power distribution

Diagram of AC Power distribution is shown in fig 3.17 and 3.18

Fig 3.17

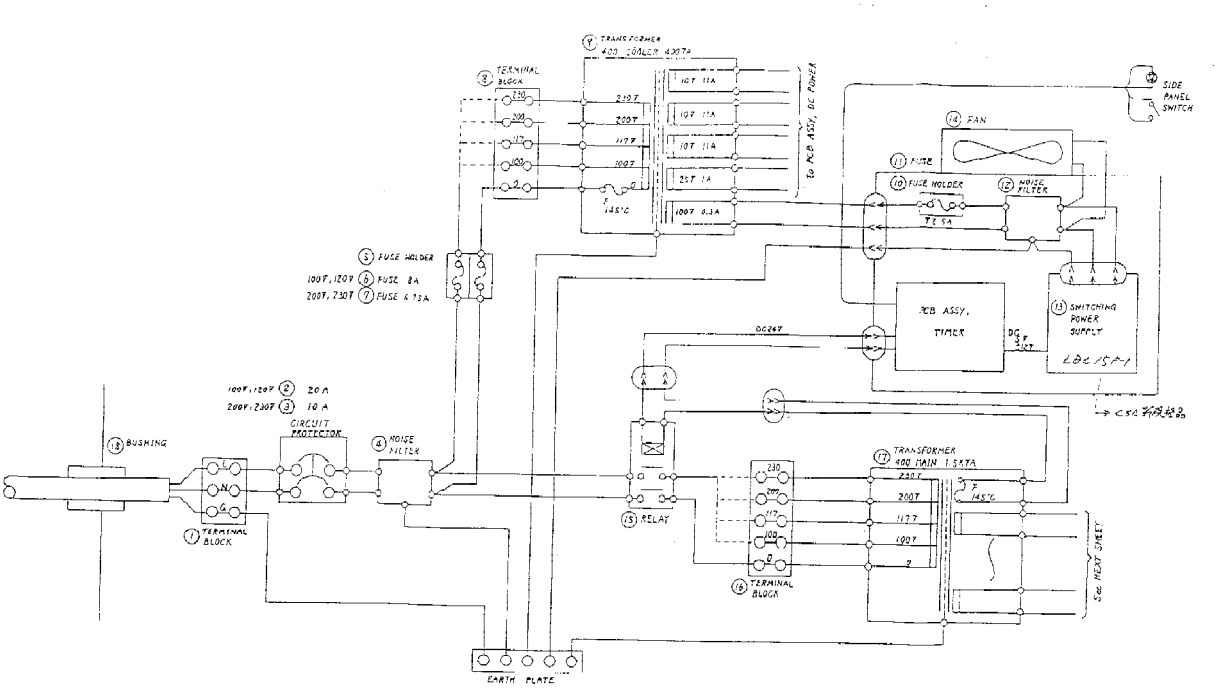
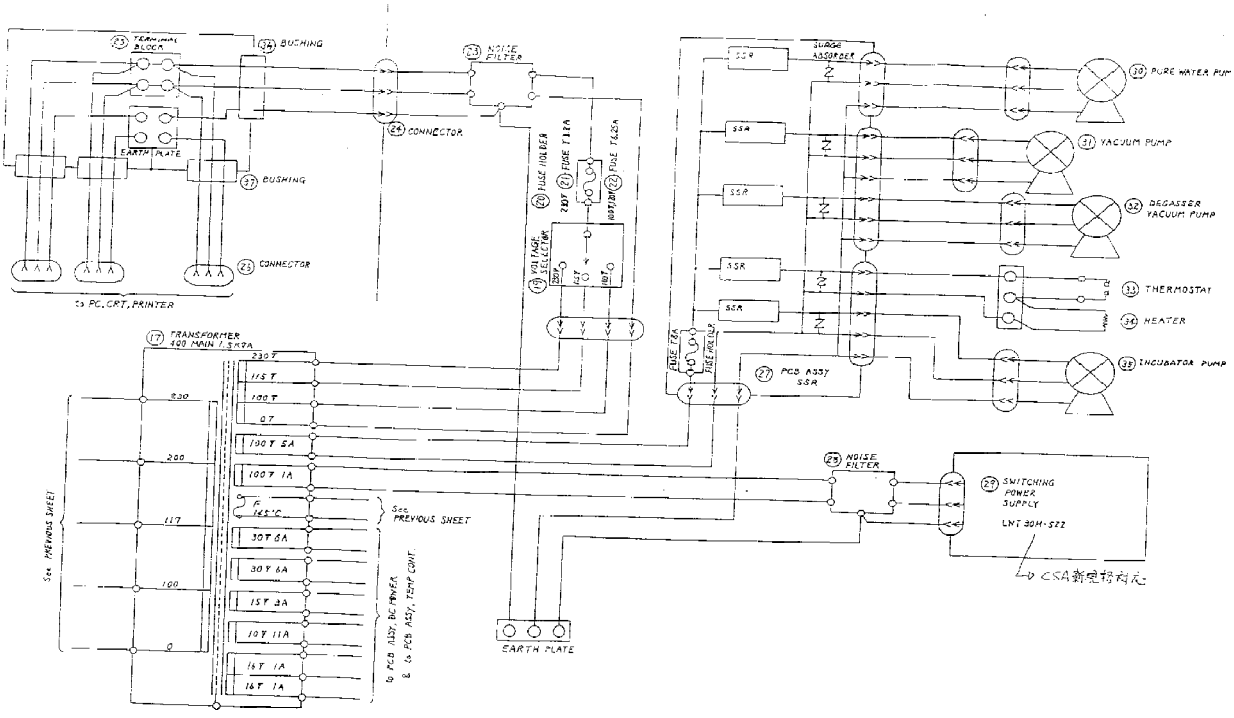


Fig 3.18



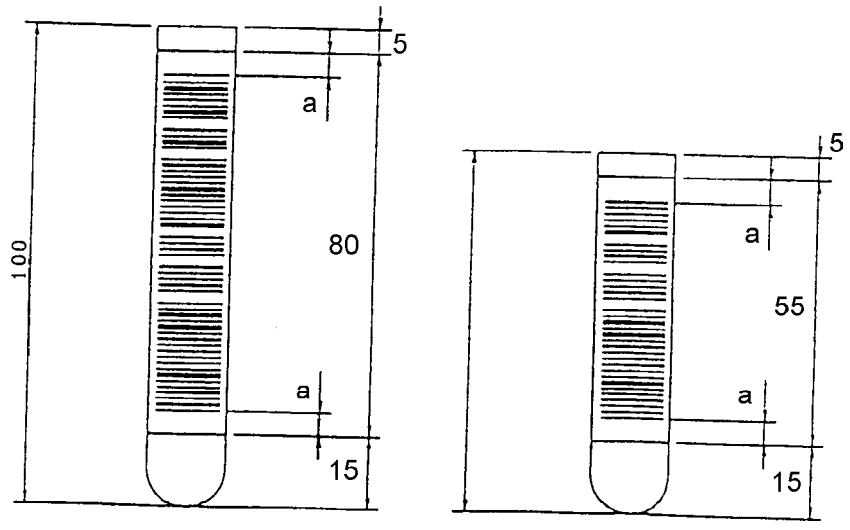
3.1.9 Operation of PID

Specifications

1. SPECIFICATIONS OF THE READER
Method: laser beam barcode reader
Wavelenght: 670 nm
Max output: 1.2 mW
Pulse lenght: 127 uul uS
Class 2 laser product (JIS C6802 (1991))
Applicable barcode standards: INTERLEAVED 2 OF 5 (ITF)
CODE 39
CODABAR (NW-7)
JAN
Barcode digits: max. 16 digits

2. SPECIFICATIONS OF THE LABEL
Bar module: Narrow width: 0.25 to 1.0 mm
Bar lenght: 12 mm or more
PCS value: 0.6 or more (reflecting rate of white: 75% or higher)
Label lenght: max 80 mm (with a 5 mm border not used)
Positioning of label on the tube: refer to fig. 3.x below
material: the material of the label and the printing should be not aging in normal use conditions

Fig 3.19 - bar code labels



3.2 Check-out and Adjustments

3.2.1 Dip switches default configurations

3.2.1.1Main CPU pcb

Set Dip Switch of Main CPU pcb with the ILab600 power OFF

Bit No	Task	Default
8	send SW from Card	OFF
7	simulating each unit	OFF
6	simulating PC	OFF
5	DEMO	OFF
4	Sample Stirring module	ON=w/mod; OFF=w/out mod.
3	RID module	ON=w/RID; OFF=w/out RID
2	PID module	ON=w/PID; OFF=w/out PID
1	ISE module	ON=w/ISE; OFF=w/out ISE

SLAVE CPUs A AND B

To be supplied (refer to label on cover of cardcage)

3.2.2 Electronic adjustments

3.2.2.1 Adjustment of Photometer Lamp Voltage (DC Power pcb)

Measure voltage on Test Points, check that all voltage are within tolerance. Adjust by specific trimmer if required.

Test Points	Voltage	Tolerance	Trimmer
TP4-TP5(gnd)	11.50VDC	+/-10mV	VR3
TP3-TP2(gnd)	2.60VDC	+/-20mV	VR2
TP1-TP2(gnd)	5.00VDC	+/-50mV	VR1

3.2.2.2 Adjustment of Reagent Tray Temperature (DC Power pcb)

a. Locate the DC Power pcb. Connect a Digital Voltmeter between TP3 and TP2 (ground). If necessary, adjust VR-2 to obtain a voltage of 2.56 vdc ± 20 mv.

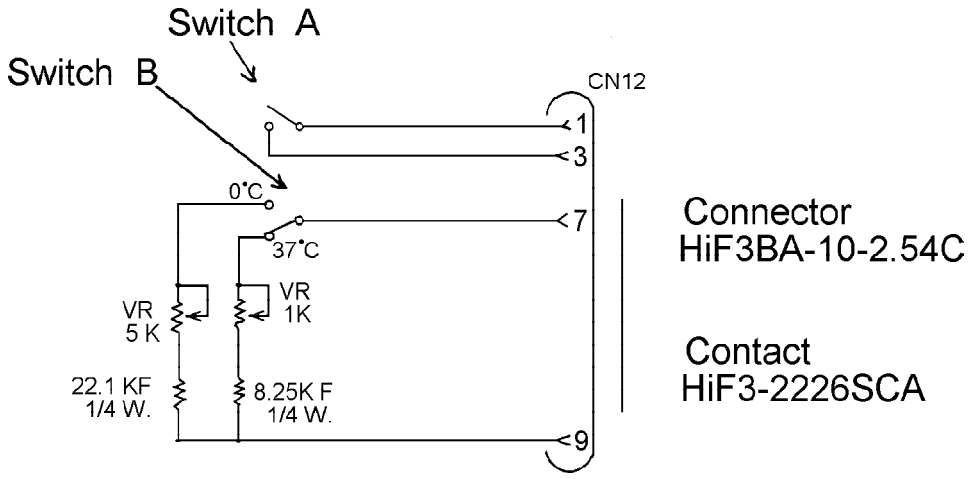
b. On the DC Power pcb disconnect the Reagent Tray thermistor CN-8. Connect a Digital Voltmeter between TP1 and TP2 (ground). If necessary, adjust VR-1 to obtain a voltage of 5.00vdc ± 50mv.

c. Reconnect the Reagent Tray thermistor CN-8.

3.2.2.3 Adjustment of Temperature Contr. pcb

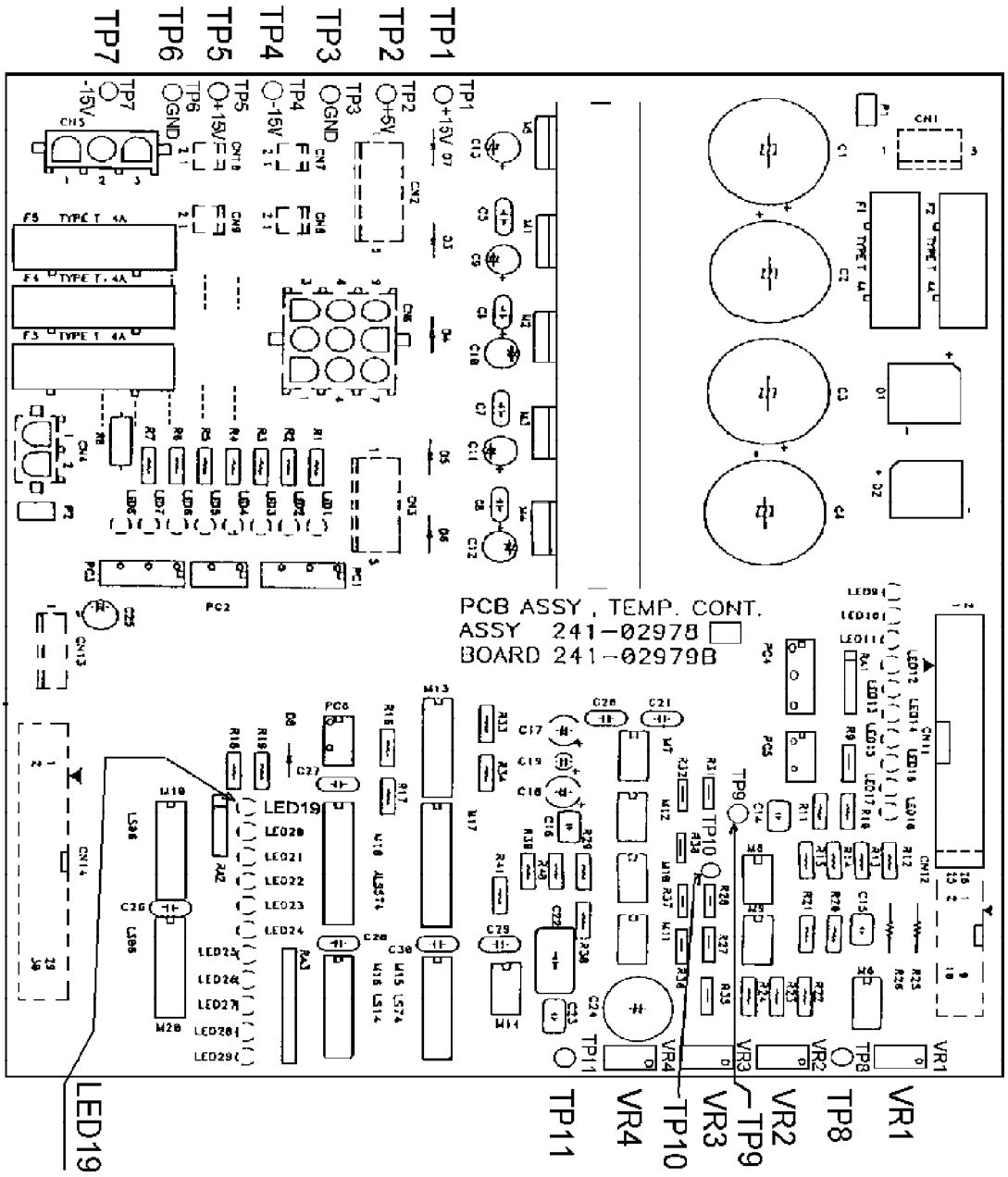
1 . Calibrate the test box. The test box output for the 37°C mode must be adjusted to 8.521KW. Set switch B to 37°C position and connect an ohmmeter to the cable connector pins 9 and 7. Adjust pot to 8.521KW.

Figure 3.20 - Temperature adjustment tool



2. Connect the test box to CN12 on the Temp Control PCB. Turn on power. (see figure 6.21 Temp Control pcb)
3. Make sure that LED19 (bath water level sensor status) is extinguished while the switch “A” on the test box is closed, and that LED19 is lit while switch “A” is open. Close switch “A”.
4. Connect the digital voltmeter between TP3 (ground) and TP8. If necessary adjust VR1 to 5.0vdc ±10mV. Paint lock VR1.
5. Set the switch to “37°C”. Connect the digital voltmeter between TP3 (ground) and TP10. If necessary adjust VR3 to -3.7vdc ±10 mV. Paint lock VR3.
6. Connect the digital voltmeter between TP3 (ground) and TP9. If necessary adjust VR2 (heater control) to +3.7vdc ±10mV.
7. Connect the digital voltmeter between TP3 (ground) and TP11. If necessary adjust VR4 (display reading) to 0vdc ±20mV.
8. Disconnect the test box and reconnect CN12 on the Temp Control bd.

Figure 3.21 - Temperature control pcb



3.2.2.4 Adjustment of PID (*and RID*) scanners

a. Remove the top cover of the analyzer in order to access to the PID (*or RID*) scanner.

b. Place some sample tubes with ID labels in the external (i.e pos. 1) and middle position (i.e. pos 31) of the sample tray

(*external and internal position of the reagent tray*)

c. Turn ON the ILab system

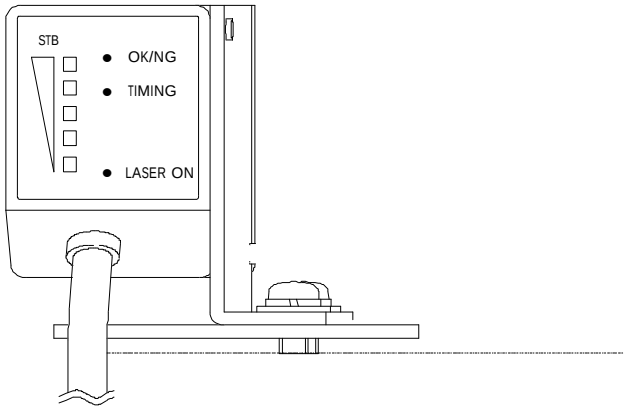
d. Enter in the "HW Maintenance" menù and set the Sample tray as follows: move to: internal sample position where the sample tube with label has been placed (i.e. pos 31) and stop to: sample bar code reading position (*set the Reagent tray as follows: move to: internal RGT position where the RGT bottle with label has been placed and stop to: RGT bar code reading position*)

e. In the "HW Maintenance" menù set the PID (*RID*) reader to "Test ON".

CAUTION: Never look directly into the laser light beam, eye injury may occur.

f. Check the reading performance of the scanner by verifying the LED indications (ref. to figure below)

Figure 3.22 - PID/RID scanner

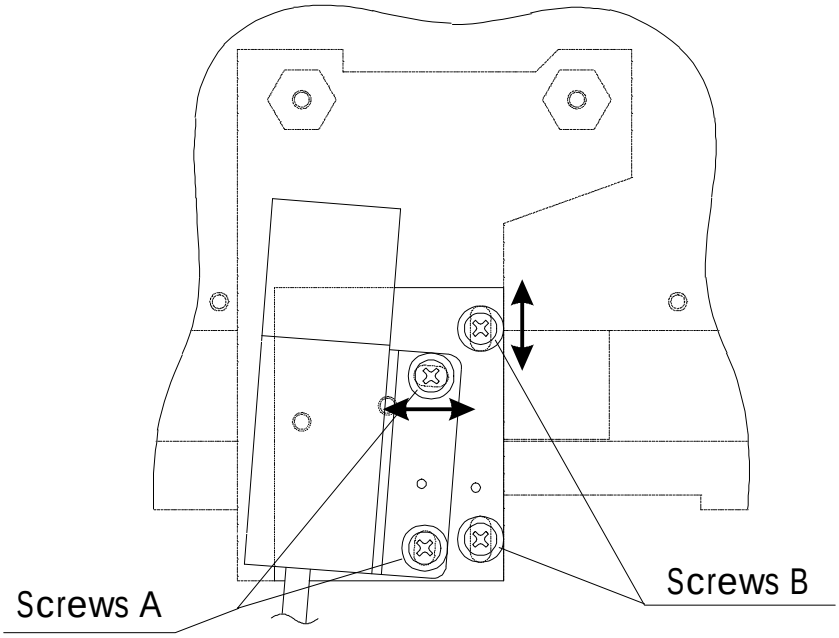


g. At this time LEDs TIMING ON and LASER ON LED are ON. LED OK/NG should be ON green color, if it is ON red color the scanner has to be adjusted. The LED bar STABILITY LEDs should be all LEDs ON if not the scanner has to be adjusted. (*Same procedure for RID*).

h. If scanner has to be adjusted, loosed the screws A and B and adjust the position of the scanner in order to get the performance required (LED OK/NG should be ON green color. The LED bar STABILITY LEDs should be all LEDs ON). (*Same procedure for RID*).

i. Move the sample tray to an external sample position where the sample tube with label has been placed and check the scanner performance by repeating the above procedure. (*Same procedure for RID*).

Figure 3.23 - Alignment of PID/RID scanner



l. Power OFF the ILab600 and re-place all covers.

3.2.2.4 Adjustment of Probe Liquid Level Sensor

This procedure is intended to be used for the adjustment of the sensitivity of the Sample, R1 and R2 probes liquid level sensors.

This procudure should be performed in the following situations:

1. When a probe is replaced.

2. Whenever sample/reagent misdetections occur during analysis.

Adjust Probe Liquid Level Sensor as follows:

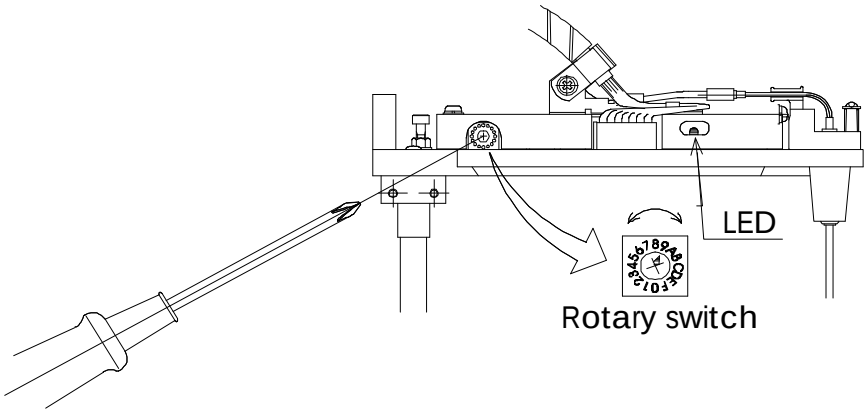
1. From the H/W Maintenance menu open the Sample Probe or Reagent Probe screen.
2. Click on Reset once. The probe performs the reset operation and then performs a water rinse in the rinse cup. This fills the probe with water.

Note: If it is not filled with water, the liquid level sensor cannot be adjusted accurately. Do not skip this step.

3. In the Replacement area click on Move for Replacement. After the reset operation, the dispensing arm tension is off, allowing the rotation of the probe by hand to the desired working position on the sample or reagent tray.

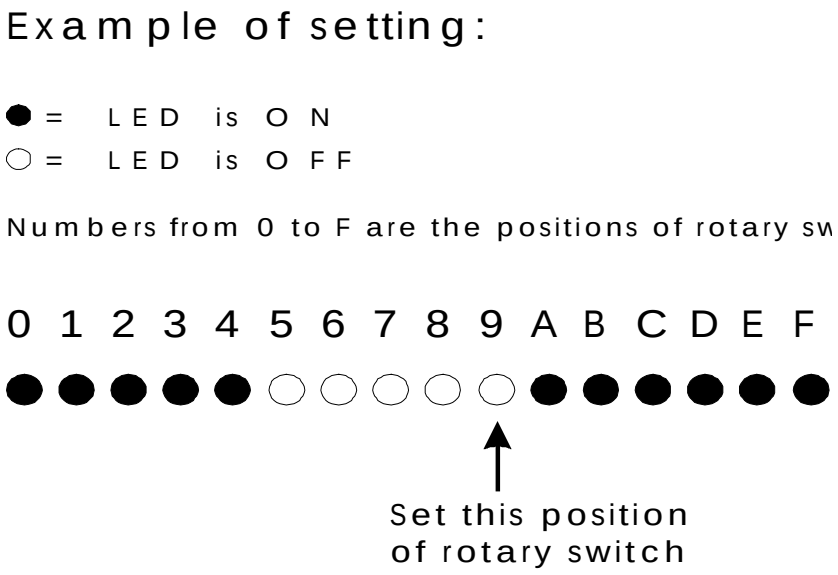
4. Remove the arm cover and slide cover
5. There is a rotary switch and red LED's in the inside of the sheet metal on the arm's right side.

Figure 3.24 - Adjustment of liquid level sensor



6. Turn the arrow on the rotary switch clockwise from 0 to F using a small screwdriver. The red LED's will go ON and OFF as the arrow is turned. Set the rotary switch to the largest number under which the red LED stays OFF. As an example, In the figure below, the LED's are OFF between N° 5 and N° 9 of the rotary switch. The rotary switch must therefore be set at N° 9. A dimly lit LED is considered to be OFF.

Figure 3.25

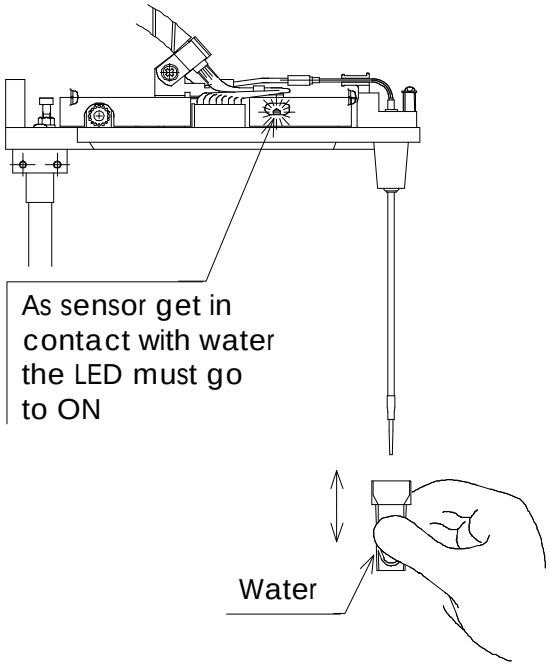

Example of setting:
● = LED is ON
○ = LED is OFF
Numbers from 0 to F are the positions of rotary sw
0 1 2 3 4 5 6 7 8 9 A B C D E F
Set this position
of rotary switch

7. After the setting is completed, fill the sample cup with water and immerse the probe in it. If the LED's which were OFF turn

ON, the probe has been set correctly.

8. Reinstall the arm cover and slide cover. Return the probe to the standby position. Close the Sample Probe screen and H/W Maintenance menu.

Figure 3.26 - adjustment of liquid level sensor



4.0 Mechanics

4.1 General description of the system

The ILab 600 includes several dedicated modules which perform the following tasks:

1. Sample dispensing
   The analyzer provides detection, sampling and dispensing of programmed sample volumes. To provide this the analyzer incorporates the use of several mechanical modules and commands from the System PC in performing this task. The Sampler dispensing module (includes sample sensing), the sample syringe module and the sample tray module provide this operation.

2. Reagent dispensing
   The analyzer provides reagent detection, aspiration and dispensing of 4 separate reagents on the analyzer. The reagents are programmed and volumes set by the System PC into two classes, Reagent 1st / 3rd and Reagent 2nd / 4th . The analyzer incorporates several mechanical modules and provides programming commands from the System PC. in performing this task. The R1/R2 reagent dispensing modules (includes reagent sensing), R1/R2 syringe modules and the reagent tray module, together provide this operation.

3. Sample stirring:
   The sample stirrer assembly provides the stirring for diluted or treated samples on the sample tray assembly only, not at the reaction cuvettes. This is an optional assembly.

4. Photometer/Reaction tray:
   The reaction tray is a turn table type, which includes 81 reaction cuvettes that are assembled in 9 sections. The reaction tray can be removed entirely and reaction cuvettes removed separately. The nine (9) assembled sections can be removed, but only for replacement purpose. The reaction takes place within the cuvette, in a thermo-controlled environment, and is measured by the photometer.

5. Wash Reaction Cells:
   The wash station evacuates, washes and fills the cuvettes with degassed water, which allows the photometer to check their optical quality. The wash stations 1st probe will evacuate the cuvettes waste into a Bio-Hazard waste container. The waste tank will have a 20 litre capacity and will alert the system between 16-17 litres. This may be selectable at the instrument service level. Wash probes 1 and 2 dispense detergent (acid and alkai) when washing cuvettes.

6. Sample tray:

The sample tray has 75 positions which are divided into three rings. There are 30 positions in the outer ring and 30 positions in the middle ring, both are bar code readable. The inner ring holds only 15 positions, which are not bar code readable. The 75 sample positions allows primary tubes, cups, or micro cups. They are held by the tray which rotates to present the samples to the sample aspirator. Up to three sample trays can be used. Sample trays are identified by a magnetic sensor.

7. Reagent tray:
   The reagent tray has 64 positions placed in a circular manner. Both the outer ring and inner ring are bar code readable. The outer most ring slots allows placement for the 20ml and 50ml reagent containers. The inner ring allows for 20ml, 50ml and 100ml reagent containers. They are held by the tray and rotated to the reagent aspirator.

4.1.1 General operation

1. Start up
   Perform the pre-work check-up, set the reagents, set the detergents perform the maintenance, such as cell washing and performing water blanks, then prepare the analyzer for analysis.

2. Enter the request and create the worklist
   Enter the analysis test of each sample from the mouse or keyboard in accordance with the menu that is displayed on the CRT, then register the request and create the work list. This supplies the positions of the samples to be placed on the sample tray assembly.

3. Placing the samples.
   Place the samples, cups or primary tubes either serum, urine, etc. onto the sample tray assembly. Be certain that the samples placed in the tray match with the numbers displayed for the work list. The system can accommodate up to three sample trays, tray 1, 2, and 3. When entering the request be selective to the tray that is present.

4. Start the analysis
   Click the (start) button on the operation menu screen or the start key on the analyzers front key pad.

5. Starting the analysis operation
   The sample tray turns and the tray number is read. The system PC confirms the tray to the work list and sends the work list to the analyzing module. The analyzer begins its operations in accordance with the work list that it has received.

6. Rinsing the cuvettes and measuring the water blank.
   The cuvette wash station begins to wash the cuvettes. The reaction disk turns 40 +1 cuvette in 9 sec, so each reaction cuvette is rinsed in each cycle while stepping forward. At the same moment the

photometer measures the absorbance of 41 reaction cuvettes going through the optical axis in 1 cycle. Cuvette blanking water is dispensed into the rinsed and clean cuvettes. A measurement is taken of the cuvette and the value will be regarded as the basic data for absorbance to be measured later. In the cuvette that has just finished being blanked, the cuvette blanking water is evacuated and removed. Then the cuvette is dried and moved to the sample position.

7. Dispensing the sample

   As the reaction cuvette moves to the sample position, the probe moves to the position above the sample tray and decends down into the sample. When the level sensor detects that the tip of the probe has entered the sample, the sample probe stops moving and aspirates the specified volume of sample. Then the probe moves to the position above the cuvette, decends down until the tip of the sample probe touches the bottom of the cuvette and discharges the sample. After that the sample probe moves to the rinsing pot where the inner and the outer surfaces are rinsed with rinsing water. This rinsing operation is omitted if the same sample is used in the next analysis. Rinsing is performed every time a different sample is analyzed.

8. Dispensing the first reagent

   Immediately after the sample probe dispenses the sample and moves to the rinse pot, the first reagent probe moves to the reaction cuvette and the reagent is dispensed. The reagent probe has already aspirated its programmed amount of reagent prior to sample dispensing.

   When the reagent probe aspirates and dispenses the reagent, it moves in a circular orbit to the position above the reagent bottle for the specified test, and moves down. When the probe sensor detects that the tip of the probe has entered the reagent it stops moving down and aspirates a specified volume of reagent. The reagent probe moves over the reaction cuvette and dispenses the reagent into the cell. Further more the probe moves to the rinsing pot where the inner and outer surfaces are rinsed with rinsing water.

9. First stirring operation

   The reaction cuvette in which the first reagent is dispensed moves 40+1 cells and stops in the stirring position where the cuvette stirrer moves over head and then moves down into the cell and provides mixing. After mixing takes place the assembly is raised and moved to the wash pot where rinsing of the stirrer takes place.

10. Photometry measurement

    When stirring of the first reagent is finished, measurement takes place. Photometry is repeatedly performed every time the reaction cell travels through the optical axis of the photometer until the reaction period is expired.

11. Dispensing and stirring the second reagent

When a second reagent is selected in the test, it will be dispensed 5min after the first reagent was dispensed. One cycle later the stirring at the cell is performed.

12. Analyzing the next sample
    After the requirements of the first sample are met and dispensed into cuvettes, the next sample is consecutively analyzed. However, if the worklist of an emergency Stat sample is sent to the analyzing module, it is given first priority.

13. Completion of the routine analysis
    9.6 min maximum after the first reagent is added measurements for the first normal analysis are complete. If the final measurement point is earlier than that, its analysis is finished when all its measuring points are read. After measurements the absorbencies or changes in absorbance are converted into the concentration unit, the data is processed and the output is sent to the CRT display and printed.

14. Rinsing the reaction cell
    The reaction solution (sample/reagent) of the reaction cuvette in which the analysis is finished is aspirated by the wash station. The cuvette is rinsed with detergents, rinsed with rinsing water and measured again with a cell blank, so the cuvette can be used in later analysis.

15. Measurement in auto rerun
    If the auto rerun is set, and the analysis result satisfies the rerun logic, the sample tray turns to the corresponding sample position and the sample is measured again. Accordingly, even if the sampling is finished the system will regard the sample active, until the result is obtained and no abnormalities are detected or rerun results are obtained. At this time the analysis is complete.

16. The 2 reaction cycle analysis
    The instrument has the ability to measure 2-reaction rounds testing. This will incorporate a third and a fourth reagent. The third reagent will be added 12.2 min after the first reagent and the fourth reagent will be added 17.2 min after the first. The maximum measurement period is 21.8 min .
    There are no applications at this time and this cycle should only be noted.

4.2 General description of the mechanics operation cycle.

The main CPU manages the jobs of the entire analyzer. During power up the main CPU Boots its ROM program, the Slave CPUs stop all operations. They compare their ROM programs, and if the Main CPU ROM program is a higher rev, this will be loaded into the slaves RAM and that program will be executed, but if they are the same the system will execute the current program to run.

4.2.1 Controlling systems

The slave CPUs are paired to provide system functions such as, drive motors, read sensors and so on. Listed below are the pairs that drive the mechanics of the analyzer.

1. Sample dispenser / Sample tray.
2. R1 dispenser / Reagent tray.
3. R2 dispenser / Sample cup stirrer
4. Stirrer assembly / Rinsing module

Photometer / Reaction tray

The slave CPUs operate exclusively when operating independently. Once the Main CPU starts a command cycle, the slave CPUs will carry it out, without any instruction from the main. After the task is complete the main will monitor a task complete and this time the slaves will only allow a new task command from the main. While such commands are executed, any other command except emergency stop cannot be carried out. Information transfer between the slave CPUs is exclusive, and performed so that each mechanism does not collide with another.

The Slave CPUs as well as the Main CPU utilize Dip Switches to perform “Off-Line” functions such as Sensor Checks, Probe Movements, etc. Refer to the tables for Dip Switch settings and corresponding functions.

4.2.2 Operation at power on

When the system is turned on, all the slave CPUs start up the common program for download. This program is located in the ROM of the slave CPUs. During boot up all mechanical elements such as motors are non operational because of the processing being performed inside the slave CPU. At this time, the execution program is transferred to RAM on the slave CPU. The rev number of the Main CPU ROM card is compared to the rev number written to the slave CPUs ROM chip. If there is a difference the latest rev from the card will be downloaded to the RAM on the slave CPUs to run. This takes considerable time to transfer, but if they match the transfer operation is not performed.
However, when the DIP switch is set to off-line mode, the download program is not executed. The contents of the ROM on the slave CPU will be transferred to the RAM on the slave CPU and executed. If a bug is present on the off-line program, the ROM itself should be changed.

4.2.3 Operation in emergency stop

When the emergency stop button is depressed, all the slave CPUs are simultaneously stopped for the emergency request. Each slave CPU in the emergency stop status immediately stops operation. In the emergency

stop status, the LED on the slave flashes with the error code indicated. In the stop status, the reset instruction can be accepted.

4.2.4 Operation reset

When the system is requested to reset, the Main CPU resets all Slave CPUs and the mechanics are reinitialized.

4.2.5 General description on the routine analysis

Keep in mind that the Ilab600 cycle timing is in 9 second intervals. The slave CPU also performs the same operation every 9 seconds during the routine of the analysis.
Note: When analysis is started or shut down slightly different operations are performed such as cell washing and rinsing are performed. For details, refer to the description on the Main CPU.
The routine analysis is controlled by the Main CPU and started by a command given by the Main. The operation start time varies depending on each Slave CPU. The start time is shown in table 4.1. The operation start time of the Photometer/ cell tray is used as reference.

Table 4.1
Operation start times

Slave CPU	Operation start time
Photometer/Cell tray	0.0 sec.
Sample dispenser/Sample tray	0.2 sec.
R1 dispenser/Reagent tray	2.6 sec.
R2 dispenser/Sample cup stirrer	7.0 sec.
Stirrer/Washing module	12 sec.

Stirring / Washing module starts up the operation more than 9 seconds later because stirring inside the cell is performed in the next cycle after dispensing of the second reagent is finished.
The time is managed closely for each operation during routine analysis. If an operation is not finished within the specified operation time, a time out error occurs.

4.2.5b Off-Line Mode Switch Settings and LED Patterns

The system can be put into the Off-Line Mode by utilizing the Dip Switches located on the Slave “A’ CPU and Slave “B” CPU pcb’s. While in the Off-Line mode the arms can be moved, magnetization patterns checked or set, and LED status can be checked by changing the dip switch positions.
Each control circuit on the Slave CPU’s (Sample Dispenser, R1 Dispenser, R2 Dispenser, Stirrer/Rinse, and Photometer) have an 8 position dip

switch (for Off-Line functions), LED's, local reset switch and a 2 position dip switch (for phase pattern).

The operation of the Off-Line Mode Dip Switch is indicated in table 4.2: (default is all bits OFF).

Table 4.2
Off-Line mode dip switch operation

Bit 7:	ON to enter Off-Line Mode
Bit 8:	Change position to activate function in off-line mode
Bit 6:	ON to release vertical motor power after rotation command is executed
Bit 5:	ON to activate stirrer paddle after stirrer rotation command is executed

Refer to figure 4.1 for locations of switches and Tables 4.4 (sample, R1, R2), 4.5 (stirrer / rinse), and 4.6 (photometer) for bit position functions. For Sensor Check LED Status refer to Table 4.7.

Figure 4.1
Off-Line Mode switch locations

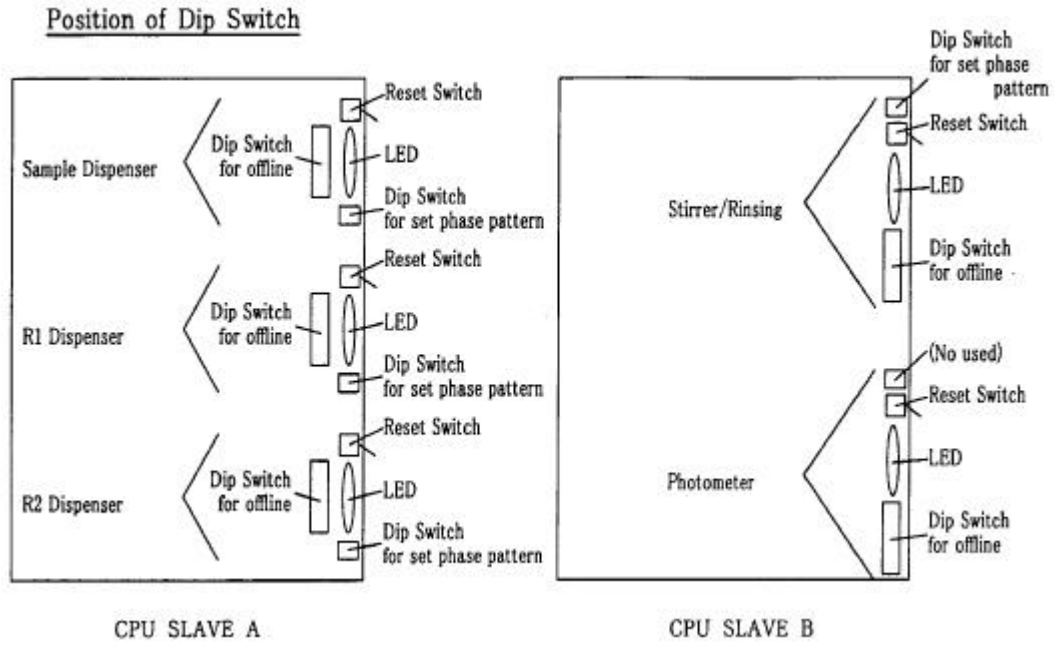


Table 4.3
Dip switch symbols / indications

Symbol	Indication of Switch Position
☒	Indicates switch bit ON
☐	Indicates switch bit OFF
⍓	Indicates switch bit position change (OFF to ON, or ON to OFF)

Table 4.4
Sample / R1 / R2 Off-Line Mode dip switch settings

Dip Switch						Sample Dispenser	R1 Dispenser	R2 Dispenser
1	2	3	4	5	6	Contents	Contents	Contents
☐	☐	☐	☐	☐	☐	Initialize all motors	Initialize all motors	Initialize all motors
☒	☐	☐	☐	☐	☐	Initialize Probe and Syringe	Initialize Probe and Syringe	Initialize Probe and syringe
☐	☒	☐	☐	☐	☐	Initialize Sample disk	Initialize Reagent disk	Initialize Sample stirrer
☒	☒	☐	☐	☐	☐	Put out PID trigger signal (The signal put out only once)	Put out RID trigger signal (The signal put out only once)	Sample stirrer paddle on (Continue until rst sw is pushed)
☐	☐	☐	☒	☐	⍓	Probe rotates cell position (Check state of bit 6 after rotate)	Probe rotate cell position (Check state of bit 6 after rotate)	Probe rotate incubator detergent (Check state of bit 6 after rotate)
☒	☐	☐	☒	☐	⍓	Probe rotate rinse pot position (Check state of bit 6 after rotate)	Probe rotate incubator position (Check state of bit 6 after rotate)	Probe rotate cell position (Check state of bit 6 after rotate)
☐	☒	☐	☒	☐	⍓	Probe rotate detergent position (Check state of bit 6 after rotate)	Probe rotate rinsing pot position (Check state of bit 6 after rotate)	Probe rotate incubator position (Check state of bit 6 after rotate)
☒	☒	☐	☒	☐	⍓	Probe rotate S-disk outer position (Check state of bit 6 after rotate)	Probe rotate detergent 1 position (Check state of bit 6 after rotate)	Probe rotate rinsing pot position (Check state of bit 6 after rotate)☐
☐	☐	☒	☒	☐	⍓	Probe rotate S-disk mid position (Check state of bit 6 after rotate)	Probe rotate detergent 2 position (Check state of bit 6 after rotate)	Probe rotate detergent 1 position (Check state of bit 6 after rotate)
☒	☐	☒	☒	☐	⍓	Probe rotate S-disk inner position (Check state of bit 6 after rotate)	Probe rotate R-disk outer position (Check state of bit 6 after rotate)	Probe rotate detergent 2 position (Check state of bit 6 after rotate)
☐	☒	☒	☒	☐	⍓		Probe rotate R-disk inner position (Check state of bit 6 after rotate)	Probe rotate R-disk outer position (Check state of bit 6 after rotate)
☒	☒	☒	☒	☐	⍓		Probe rotate S-disk mid position (Check state of bit 6 after rotate)	Probe rotate R-disk inner position (Check state of bit 6 after rotate)
☐	☐	☐	☐	☒	⍓			Sample stirrer move to rinsing pot (Check state of bit 6 after move)
☒	☐	☐	☐	☒	⍓			Sample stirrer move detergent pos (Check state of bit 6 after move)
☐	☒	☐	☐	☒	⍓			Sample stirrer move S-disk outer (Check state of bit 6 after move)
☒	☒	☐	☐	☒	⍓			Sample stirrer move S-disk middle (Check state of bit 6 after move)
☐	☐	☒	☒	☒	☒	Check ISE status (Indicate LED see table xxxxx		Check sample stirrer sensor (Indicate LED see table xxxx
☒	☐	☒	☒	☒	☒	Check level sensor (Indicate LED see table xxxx	Check level sensor (Indicate LED see table xxxx	Check level sensor (Indicate LED see table xxxx
☐	☒	☒	☒	☒	☒	Set phase pattern	Set phase pattern	Set phase pattern
☒	☒	☒	☒	☒	☒	Check sensors (Indicate LED see table 4.7	Check sensors (Indicate LED see table 4.7	Check sensors (Indicate LED see table 4.7

Table 4.5
Stirrer / Rinse Off-Line Mode dip switch settings

Dip switch						Stirrer / Rinsing
1	2	3	4	5	6	Contents
☐	☐	☐	☐	☐	☐	Initial all motors
☒	☐	☐	☐	☐	☐	Initialize stirrer
☐	☒	☐	☐	☐	☐	Initialize rinsing probe
☒	☒	☐	☐	☐	☐	Stirrer paddle on (Continue until reset sw is pushed)
☐	☐	☒	☐	☐	☐	Rinse probe vertical excitation OFF
☒	☐	☐	☒	☐	⧄	Stirrer rotate rinsing pot position (Check state of bit 5, 6, after rotate)
☐	☒	☐	☒	☐	⧄	
☒	☒	☐	☒	☐	⧄	Stirrer rotate stirrer ½ position (Check state of bit 5, 6, after rotate)
☐	☒	☒	☒	☒	☒	Set phase pattern
☒	☒	☒	☒	☒	☒	Check sensors (Indicate LED see table 4.7
☒	☒	☒	☐	☐	☐	Rinsing cell
⧄	⧄	☒	☐	☐	☐	Fill up detergent Detergent is designated by bit 1, 2

Table 4.6
Photometer Off-Line Mode dip switch settings

Dip Switch			Photometer
4	5	6	Contents
☐	☐	☐	Initial reaction disk
☒	☐	☐	Reaction disk rotate (40 cuvettes)
☐	☒	☐	Reaction disk rotate (1 cuvette)
☒	☒	☐	Reaction disk rotate (Repeat 40 cuvettes + 1 cuvette)
☐	☒	☒	
☒	☒	☒	Check sensors (Indicate LED see table 4.7

Table 4.7
Off-Line Mode LED indications

	Sample Dispenser
LED 8	Sample disk number read sensor (ON = No flag in sensor, OFF =Flag in sensor)
LED 7	Sample disk horizontal sensor (ON = No flag in sensor, OFF = Flag in sensor)
LED 6	Sample disk horizontal initial sensor (ON = No flag in sensor, OFF = Flag in sensor)
LED 5	Sample syringe vertical sensor (ON = No flag in sensor, OFF = Flag in sensor)
LED 4	Sample probe shock sensor (ON = No flag in sensor, OFF = Flag in sensor)
LED 3	(not used)
LED 2	Sample probe horizontal sensor (ON = Flag in sensor, OFF = No flag in sensor)
LED 1	Sample probe vertical sensor (ON = No flag in sensor, OFF = Flag in sensor)
	R1 Dispenser
LED 16	Reaction disk under rotation signal (ON = Busy, OFF = Ready)
LED 15	Reagent disk horizontal sensor (ON = No flag in sensor, OFF = Flag in sensor)
LED 14	Reagent disk horizontal initial sensor (ON = No flag in sensor, OFF = Flag in sensor)
LED 13	R1 syringe vertical sensor (ON = No flag in sensor, OFF = Flag in sensor)
LED 12	R1 probe shock sensor (ON = No flag in sensor, OFF = Flag in sensor)
LED 11	R1 probe horizontal substitute sensor (ON = No flag in sensor, OFF = Flag in sensor)
LED 10	R1 probe horizontal main sensor (ON = Flag in sensor, OFF = No flag in sensor)
LED 9	R1 probe vertical sensor (ON = No flag in sensor, OFF = Flag in sensor)
	R2 Dispenser
LED 24	Sample disk under rotation signal (ON = Busy, OFF = Ready)
LED 23	Reagent disk under rotation signal (ON = Busy, OFF = Ready)
LED 22	Reaction disk under rotation signal (ON = Busy, OFF = ready)
LED 21	R2 syringe vertical sensor (ON = No flag in sensor, OFF = Flag in sensor)
LED 20	R2 probe shock sensor (ON = No flag in sensor, OFF = Flag in sensor)
LED 19	R2 probe horizontal substitute sensor (ON = Flag in sensor, OFF = No flag in sensor)
LED 18	R2 probe horizontal main sensor (ON = Flag in sensor, OFF = No flag in sensor)
LED 17	R2 probe vertical sensor (ON = No flag in sensor, OFF = Flag in sensor)
	Stirrer / Rinsing
LED 8	(not used)
LED 7	(not used)
LED 6	Reaction disk under rotation signal (ON = Busy, OFF = Ready)
LED 5	Rinsing vertical lower sensor (ON = No flag in sensor, OFF = Flag in sensor)
LED 4	Rinsing vertical upper sensor (ON = No flag in sensor, OFF = Flag in sensor)
LED 3	Stirrer horizontal substitute sensor (ON = Flag in sensor, OFF = No flag in sensor)
LED 2	Stirrer horizontal main sensor (ON = No flag in sensor, OFF = Flag in sensor)
LED 1	Stirrer vertical sensor (ON = No flag in sensor, OFF = Flag in sensor)
	Photometer
LED 16	24 Volt fuse FS-6 (ON = OK, OFF = Open)
LED 15	Stirrer under down signal (ON = Busy, OFF = Ready)
LED 14	Sample probe under down signal (ON = Busy, OFF = Ready)
LED 13	R1 probe under down signal (ON = Busy, OFF = Ready)
LED 12	R2 probe under down signal (ON = Busy, OFF = Ready)
LED 11	Reaction disk horizontal sensor (ON = Flag in sensor, OFF = No flag in sensor)
LED 10	Reaction disk horizontal phase sensor (ON = Flag in sensor, OFF = No flag in sensor)
LED 9	Reaction disk horizontal initial sensor (ON = Flag in sensor, OFF = No flag in sensor)

4.2.6 Sample dispensing

The sample dispensing consists of the sample probe, the probe drive assembly, the syringe pump assembly and the sample tray assembly.

The sample dispenser aspirates the sample from the sample tray assembly, by the programmed quantity, moves and dispenses this into the reaction cuvette. When the sample is diluted inside the cuvette, the sample dispenser aspirates the diluted sample and dispenses it into the next cuvette.
When the instrument is installed with the ISE module the sample dispenser assembly is also used to detect the level height of the sample that is used for the ISE.

Specifications	Sample dispenser
Sample volume	:2 to 40 µl variable in 1 µl steps.
Excessive sample volume	:10 µl To prevent unnecessary dilution of the sample,(sample header). When the same sample is continuously sampled, the excessive sample volume is performed at the first aspiration exclusively.
Predilution inside the cell	:The sample diluted inside the cell is aspirated and dispensed into the next reaction cell.
Sample probe	:Single probe type, electrostatic capacity level sensor method.
Shock sensor	:Used to stop downward movement of the probe when it comes in contact with a foreign object.
Down limit	:A function to set a down limit at the bottom of a sample vessel utilizing the shock sensor as sensing guide.

The inner and outer walls of the sample probe are rinsed at the wash pot first. Then the sample probe moves down to the sample aspirate position at the sample tray. The sample probe detects the level of the sample, immerses the tip into the sample by a specified distance, and aspirates the requested volume for that test. The immersion distance of the tip of the probe varies This is dependent on, the volume requested for the sample, the sample vessel type and the level height of the sample. (refer to paragraph 4.2.6.1)

When the sample is aspirated, air is aspirated between water and sample, then the specified sample plus the excessive sample (10µl sample header) are aspirated. During consecutive sampling from the same sample, the excessive sample (10µl header) remains in the sample probe until all test requirements are aspirated for that sample.
After aspiration, the probe moves down into the cuvette and dispenses the sample into the bottom of the cuvette. At this time, if the dispensed volume is 9 µl or less, the probe will move up and down with a short stroke after it has discharged the sample into the cuvette.

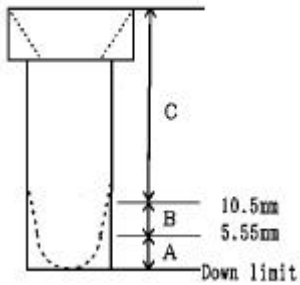
After dispensing the probe returns to the position above the wash pot. When the same sample is continuously analyzed, the probe starts the next aspirate cycle. When the next sample is analyzed, the inner and outer walls of the probe are rinsed inside the wash pot and the sample probe starts its next cycle.

Note: The sample vessel is either a sample cup, primary tube, or micro cup. This is a request that is made when entering information at the patient test menu. When selecting the sample cup or tube remember this must match the type that was selected in the test menu. If the sample cup type is not the same as requested in the patient test menu, the data may be affected by the aspiration of air, etc.

4.2.6.1. Follow-up move-down of the sample probe

The sample probe performs follow-up move-down (FUMD) for the standard cup and the micro cup when a sample is aspirated. The distance by which the liquid level is decreased by aspiration of the sample is determined based on the liquid level position detected and the total aspiration quantity, so the probe is moved down by the corresponding distance insuring that the probe remains in the sample during the aspiration cycle. The total aspiration quantity consists of the specified volume and the excessive sample (sample header).
The FUMD is not performed when primary tubes are used.
The sample probe vertical movement drives a distance of 0.15mm/pulse

Aspiration volumes indicated exclude excessive sample (10µl header)



Standard Cup

When sample detection is within range “A”

- Total aspiration ≤ 5µl : Down 2 pulses
- Total aspiration 6µl to 10µl : Down 6 pulses
- Total aspiration 11µl to 20µl : Down 10 pulses
- Total aspiration 21µl to 40µl : Down 14 pulses
- Total aspiration ≥ 41µl : Down 18 pulses

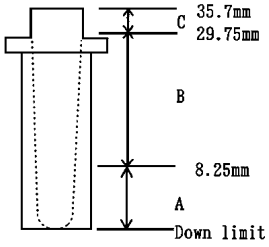
When sample detection is within range “B”

- Total aspiration ≤ 40µl : Down 6 pulses
- Total aspiration ≥ 41µl : Down 12 pulses

When sample detection in within range “C”

- Total aspiration ≤ 40µl : No additional pulses
- Total aspiration ≥ 41µl : Down 6 pulses

Sample volumes indicated exclude excessive sample (10µl header)



Micro Cup

When sample detection is within range “A”

- Total aspiration ≤ 10µl : Down 3 pulses
- Total aspiration 11µl to 20µl : Down 8 pulses
- Total aspiration 21µl to 30µl : Down 13 pulses
- Total aspiration 31µl to 40µl : Down 16 pulses
- Total aspiration ≥ 41µl : Down 23 pulses

When sample detection is within range “B”

- Total aspiration ≤ 10µl : No additional pulses
- Total aspiration 11µl to 20µl : Down 3 pulses
- Total aspiration 21µl to 30µl : Down 6 pulses
- Total aspiration 31µl to 40µl : Down 10 pulses
- Total aspiration ≥ 41µl : Down 15 pulses

When sample detection is within range “C”

- Total aspiration ≤ 20µl : No additional pulses
- Total aspiration ≥ 21µl : Down 6 pulses

4.2.7 Hardware description Sampler assembly

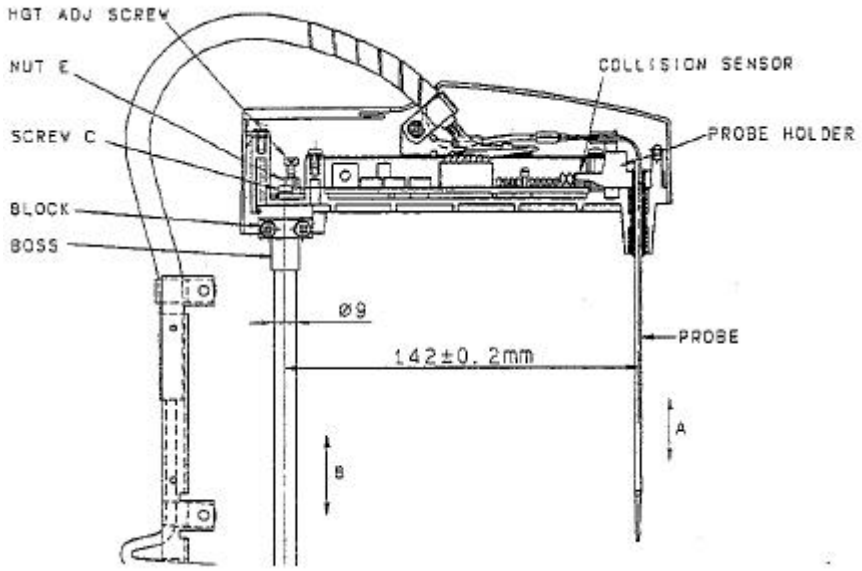
The sampler assembly is made up of two drive motors, encoder disc, sensor, sensor PCB, a shaft drive assembly, and a sampler head assembly mounted on the shaft of the sampler housing. The two motors are used to drive the assembly vertically up or down and rotationally clockwise or counterclockwise. This is accomplished by drive belts and worm gears and the stepping of the motors driven by software commands. The sensors detect various positions for the sampler to be in and sends this information to the sampler control systems. The sampler head assembly houses the sample connector nozzle PCB, which supplies the capacitance sensing and shock sensing for the probe assembly.

4.2.8 Sampling module check-out and adjustments

The sampler assembly consist of the Sampler arm assembly (1),the Sample tray assembly (2), the sample syringe assembly (3), and the Slave A PCB assembly. Mechanical adjustments are made on the individual assemblies themselves. The electronic drive and control circuitry are contained on the Slave A CPU, Driver A and Driver B pcb’s. Electronic home adjustment is made on the Slave A CPU pcb. For adjustment of the sample sensor and shock sensor refer to Electronics section .

On the Slave A CPU bit switch SW2 is used to enter the Off-Line Mode, to perform checks and mechanical alignments. Return Dip Switch SW2 to the default positions after performing any procedures or checks.
Refer to figure 4.2 for mechanical adjustments of the Sample Arm

Figure 4.2
Sample arm adjustment



1. Adjustment of the probe arm

1. Make sure that the sample probe is attached to the probe holder without backlash.
2. Make sure that the probe holder moves smoothly up and down against the chassis and the arm, also that the collision sensor is not in contact with the light shielding plate.
3. Make sure that the vertical movement shaft and the probe are in parallel and that the probe is not tilted while being moved.
4. Adjust the clearance between the probe and the vertical movement shaft to 142±0.2mm, then tighten the two locking screws, (C).

2. Adjusting the sample drive module

1. Adjust attachment of the motor so that the backlash of the gear becomes 0.1 to 0.3 mm in the outer of the sector. Confirm the backlash at four corners of the drive gear.
2. Make sure that the sampler drive module rotates smoothly.

3. Turing on the power and checking the sensor

1. The sample arm drive module and the syringe pumps should already be adjusted in accordance with each assembly drawing or adjustment procedure.
2. Insure system power is on.
3. Select Sensor Check from the off-line mode using the DIP switch SW2 provided on the slave A CPU assembly.
   Set Bit 7 to ON
   Depress the RESET switch
   Set Bits 1-6 to ON
   Set Bit 8 to ON (start operation)

The sensor status is indicated by the LEDs.
Check the LED indication table (4.7) Check Sensor, Sample Dispenser. insure all sensors are operating correctly.

4. Reset Dip Switch SW2 to the default positions.

4. Setting the Magnetization pattern (electronic home)

1. Set the magnetization pattern in the off-line mode using the DIP switch for saving the magnetization pattern (SW3) provided on the Slave A PCB Assembly
2. Enter the off-line mode using Dip switch SW2.
   Set Bit 7 to ON.
   Depress the RESET switch.
   Set Bits 2 thru 6 to the ON position.
   Change over Bit 8.-Operation is started.
3. Observe LEDs D1 and D2. If either of the LEDs are flashing change the position of Dip switch SW3 Bits 1 and 2 so that the LED's D1 and D2 do not flash. When all the LED's are on, the setting is complete. Dip switch SW3 bit 1 corresponds to LED D1 and bit 2 corresponds to LED D2.
4. Change over SW2 Bit 8. Insure that the sample arm is stopped in the sample position and LEDs D1 and D2 are ON. If LEDs D1 or D2 are flashing repeat the procedure. If LEDs D1 and D2 are ON the magnetization pattern is set correctly.
5. If necessary change the label on the CPU Box front cover to reflect the correct settings for Dip Switch 3.
6. Reset Dip Switch SW2 to the default positions.

5. Reset operation

1. Set Dip Switch on the Slave A CPU PCB as follows.
   Check and see that Bit 7 is set to the on position. (Now, the off- line mode is selected.)
2. Depress the reset switch.
3. Change over Bit 8 . Depress the reset switch, reset operation.
   (The reset command specifies that Bit 7 exclusively should be set to the on position, all other bits off).
4. After that, change over Bit 8 to reset the unit.

6. Adjusting the Vertical height position of the probe.

1. Perform the reset operation. (See section 5)
2. Enter the Off-Line Mode SW2 Bit 7 ON, and depress Reset switch.
3. Move the probe arm to the cuvette.
   Set SW2 bit 4 to ON
   Change position of SW2 Bit 8. (start operation)
4. The distance from the top face of the cuvette holder to the tip of the probe should be 11.1±0.2mm.
5. If height adjustment is necessary, loosen the 2 allen screws securing the arm to the vertical shaft. Loosen the height adjustment

screw locking nut and adjust the height adjustment screw until the distance between the tip of the probe and the cuvette holder top face is 11.1 ± 0.2mm. Tighten the height adjustment screw locking nut. Tighten allen screws securing arm to vertical shaft.

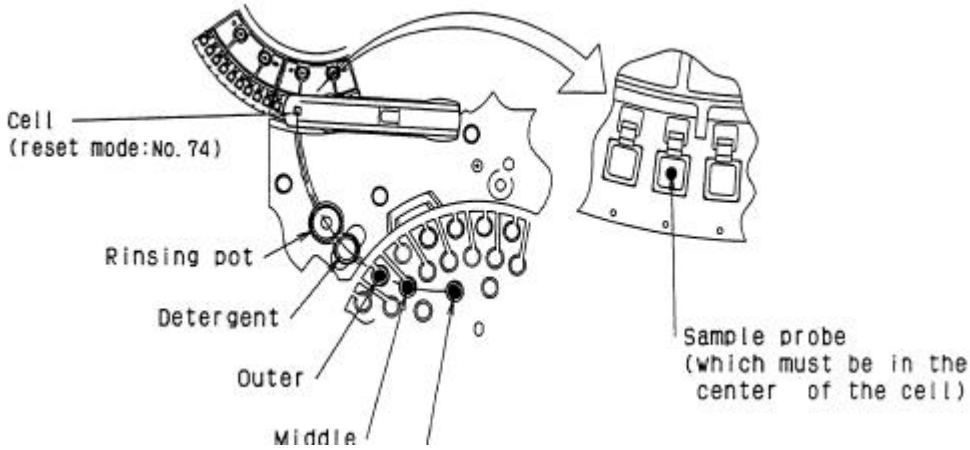
6. Reset Dip Switch SW2 to default position.
7. After adjusting height perform probe horizontal alignments.

7. Adjusting the Horizontal Arm position at cuvette

1 Insure the Reaction Disk is properly aligned prior to adjusting the sample probe arm.

2. Move the probe to the cuvette position in the off line mode.
   SW2 Bit 7 to ON.
   Depress Reset switch.
   Set SW2 Bit 4 to ON.
   Change position of SW2 Bit 8. (start operation)
3. With the probe over the cuvette insure sample probe is centered in the cuvette. If necessary loosen the 2 allen screws securing the arm to the vertical shaft. Rotate the arm until the probe is centered over the cuvette. Tighten the 2 allen screws securing the arm to the vertical shaft.
4. Reset Dip Switch SW2 to the default positions.

Figure 4.3
Sample probe rotational adjustment



8. Adjusting the rinsing pot position

1. Move the probe arm to the rinsing pot position, in the off-line mode.
2. Set Dip Switch SW2 Bit 7 to ON.
   Depress the Reset Switch.
   Set SW2 Bit 1 and 4 to ON.
   Change position of SW2 bit 8. (start operation)

3. If necessary loosen the screws securing the rinse pot and adjust the rinse pot so that the probe is centered in the pot. (allowable error:±0.2mm). Tighten the screws securing the rinse pot.
4. Move the probe to the detergent bottle position.
   Set SW2 Bit 1 and 4 to OFF.
   Set SW2 Bit 2 and 4 to ON.
   Depress the Reset Switch.
   Change the position of SW2 Bit 8. (start operation)
5. Insure the probe is near the center of the detergent bottle.
6. Reset Dip Switch SW2 to the default positions.

9. Adjusting the sample disk position

1. Move the probe to the sample disk position in the off-line mode. (outer position)
   Set Dip Switch SW2 Bit 7 to ON.
   Depress the Reset switch.
   Set SW2 Bit 1, 2, and 4 to ON.
   Change position of SW2 Bit 8. (start operation)
2. The probe should be over the center of the cup position. If necessary adjust the Sample Tray collar to align the tray with the probe.
   2.1 Reset the arm and remove the sample tray.
   2.2 Loosen the 6 screws securing the sample tray collar and adjust the tray as necessary.
   2.3 Tighten the 6 screws securing the sample tray collar. Install the sample tray.
   2.4 Repeat steps 1 and 2 above to confirm alignment of probe and sample tray.
3. Verify alignment of the sample probe for the center and inner positions. Repeat steps 1 and 2 above. Switch settings for SW2 are as follows;
   Center Position SW2 bit 3 and 4 to ON.
   Inner Position SW2 bit 1, 3 and 4 to ON.
4. Reset Dip Switch SW2 to the default positions.

10. Sample arm encoder disk adjustment

The probe arm drive assemblies are identical (sample, R1 and R2) except for the encoder disks which control the stopping positions of the arms. If swapping/replacing of arm drive assemblies is required make sure that the correct encoder disk is used. Each encoder disk is identified by letter designations printed on the disk as follows:

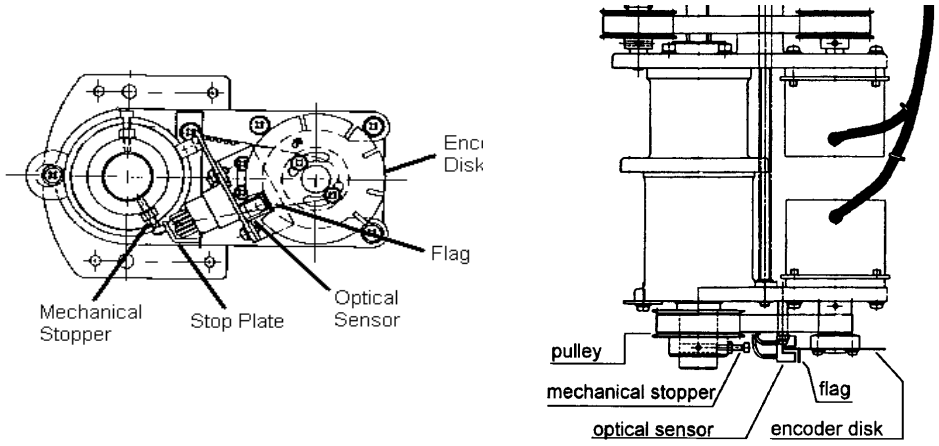
SP = Sample Pipette Arm Drive
1 = R1 Arm Drive
2 = R2 Arm Drive
ST = Stirrer Arm Drive

Encoder disks may be removed by removing the two fixing screws. If the encoder disk is removed the encoder disk alignment procedure must be performed.

Encoder Disk Alignment Procedure

1. Loosen the two fixing screws securing the sample arm encoder disk to the hub.
2. Manually rotate the pulley counterclockwise so that the mechanical stopper is against the stop plate. Refer to figure 4.4

Figure 4.4
Sample arm encoder disk



3. With the mechanical stopper against the stop plate the flag on the encoder disk should be aligned (in line) with the optical sensor. If not rotate the encoder disk to align flag with optical sensor.
4. With the mechanical stopper against the stop plate and the flag aligned with the optical sensor tighten the encoder disk fixing screws.
5. After alignment of encoder disk perform the Electronic Home (Magnatization) procedure and the arm rotational alignment procedures.

4.2.9 Sample syringe module

The sample syringe module utilizes a positive displacement syringe for sample volume metering.
The major components of the sample syringe module are the sample syringe body and plunger, stepper motor, solenoid valve, and connector pump pcb. Syringe module control is provided from the Slave “A” pcb and I/O Driver “B” pcb.
The stepper motor drives the syringe plunger via a flexible metal drive belt. An optical detector is used to sense the “Home Position” and for error detection. A mechanical stop is incorporated to prevent excessive drive in the event of a circuit failure. The solenoid valve directs liquid flow, ie. sample aspiration and dispensing, diluent dispensing and probe rinsing. The pump connector pcb provides connections for the solenoid valve, stepper motor and interface to the I/O Driver “B” pcb.

The sample syringe module is identical to the R1/R2 syringe modules with the exception of the syringe body and plunger, and the home sensor flag.

There are no adjustments required on the syringe module.

4.3 Reagent (R1&R2) dispensing.

The analyzer provides reagent detection, aspiration and dispensing of two separate reagents on the analyzer. The reagents are programmed and volumes set by the System PC into two classes, Reagent 1 and Reagent 2. The analyzer incorporates several mechanical modules and provides programming commands from the System PC in performing this task. The R1/R2 reagent dispensing modules (includes reagent sensing), R1/R2 syringe modules and the reagent tray module, together provide this operation.

4.3.1 Reagent dispensing cycle description.

1. Dispensing the first reagent
   Immediately after the sample probe dispenses the sample and moves to the rinse pot, the first reagent probe moves to the reaction cuvette and the reagent is dispensed. The reagent probe has already aspirated its programmed amount of reagent prior to sample dispensing.
   When the reagent probe aspirates and dispenses the reagent, it moves in a circular orbit to the position above the reagent bottle for the specified test, and moves down. When the probe sensor detects that the tip of the probe has entered the reagent it stops moving down and aspirates a specified volume of reagent. The reagent probe moves over the reaction cuvette and dispenses the reagent into the cell. Further more the probe moves to the rinsing pot where the inner and outer surfaces are rinsed with rinsing water.

2. First stirring operation
   The reaction cuvette in which the first reagent is dispensed moves 40+1 cells and stops in the stirring position where the cuvette stirrer moves over head and then moves down into the cell and provides mixing. After mixing takes place the assembly is raised and moved to the wash pot where rinsing takes place.

3. Photometry measurement with first reagent
   When stirring of the first regent is finished, measurement takes place. Photometry is repeatedly performed every time the reaction cell travels through the optical axis of the photometer and until the reaction period is expired.
4. Dispensing and stirring the second reagent

When a second reagent is selected in the test, it will be dispensed 5min after the first reagent was dispensed. One cycle later the stirring at the cell is performed.

5. Photometry measurement with second reagent
   When stirring of the second reagent is finished, measurement takes place. Photometry is repeatedly performed every time the reaction cell travels through the optical axis of the photometer and until the reaction period is expired.

6. The 2 reaction cycle analysis
   The instrument has the ability to measure 2-reaction rounds testing. This will incorporate a third and a fourth reagent. The third reagent will be added 12.2 min after the first reagent and the fourth reagent will be added 17.2 min after the first. The maximum measurement period is 21.8 min .
   There are no applications at this time and this cycle should only be noted.
   The analyzer uses two reagent dispensing systems. There is one, 1st / 3rd reagent and one, 2nd / 4th reagent. The total reagent and diluent dispensing volumes are under computer software control and are adjustable in 5µl steps through a range of 20-200µl for reagents 1,2,3 and 4.
   A. Inaccuracy is typically less than 2.5% at 30µl or more.
   B. Imprecision is typically less than 1.2% at 30µl or more.

4.3.1.1 Follow-up move-down of reagent probe

When the reagent probe detects the liquid surface in the reagent bottle the probe will move down a fix distance specific to that bottle type and size. The reagent probe is moved down immediately after detection of the liquid surface. Regardless of the bottle size the reagent probe will always move down 5 pulses (dipping depth). Reagent probe move-down specifications are indicated below. The reagent probe vertical movement drives a distance of 0.15mm/pulse

Bottle size	Move-down pulses	
20 ml bottle	12 pulses	[7 pulses move down + 5 pulses dipping depth]
50 ml bottle	7 pulses	[2 pulses move down + 5 pulses dipping depth]
100 ml bottle	5 pulses	[0 pulses move down + 5 pulses dipping depth]

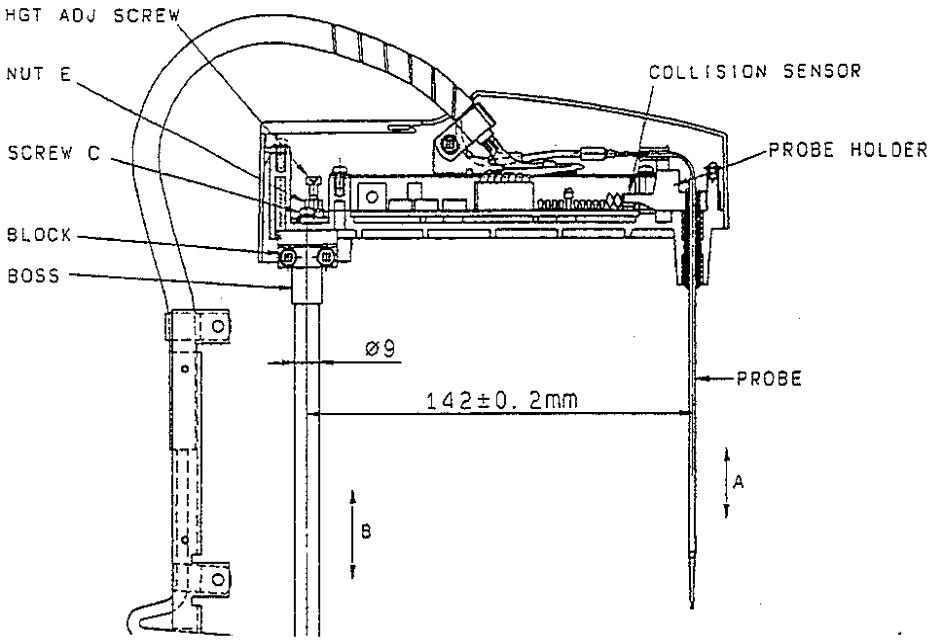
4.3.2 R1 & R2 check- out and adjustments.

The reagent dispensing is provided with 2 independent reagent dispenser assemblies. These assemblies perform the task in transporting the reagent probes over the reagent tray, wash pots and

reaction cuvettes. They provide vertical and horizontal movement for the reagent probes, this allows the probes to move into the reagent containers and sense the reagent. The reagent syringe modules, also independent and programmed by the system PC now aspirate the programmed amount of reagent and diluent. The reagent dispensing assemblies then move to the reaction cuvettes, lower and dispense the programmed amount of reagent and diluent into the reaction cuvettes.

On the Slave A CPU bit switch SW5 for R1 and SW8 for R2 is used to enter the Off-Line Mode, to perform checks and mechanical alignments. Return Dip Switch SW5 or SW8 to the default positions after performing any procedures or checks.
Refer to figure 4.5 for mechanical adjustments of the Reagent Arms.

Figure 4.5
Reagent arm adjustment



1. Adjustment of the probe arm

1. Make sure that the reagent probe is attached to the probe holder without backlash.
2. Make sure that the probe holder moves smoothly up and down against the chassis and the arm, also that the collision sensor is not in contact with the light shielding plate.
3. Make sure that the vertical movement shaft and the probe are in parallel and that the probe is not tilted while being moved.

4. Adjust the clearance between the probe and the vertical movement shaft to 142±0.2mm, then tighten the locking screw, (C).

2. Adjusting the reagent drive module

1. Adjust attachment of the motor so that the backlash of the gear becomes 0.1 to 0.3 mm in the outer of the sector. Confirm the backlash at four corners of the drive gear.
2. Make sure that the reagent drive module rotates smoothly.

3. Turing on the power and checking the sensor

1. The reagent arm drive module and the syringe pumps should already be adjusted in accordance with each assembly drawing or adjustment procedure.
2. Insure system power is on.
3. Select Sensor Check from the off-line mode using the DIP switch SW5 (R1)or SW8 (R2) provided on the slave A CPU assembly.
   Set Bit 7 to ON
   Depress the RESET switch
   Set Bits 1-6 to ON
   Set Bit 8 to ON (start operation)
   The sensor status is indicated by the LEDs.
   Check the LED indication table (4.) Check Sensor, Reagent Dispenser. Insure all sensors are operating correctly.
4. Reset Dip Switch SW5 or SW8 to the default positions.

4. Setting the Magnetization pattern (electronic home)

1. Set the magnetization pattern in the off-line mode using the DIP switch for saving the magnetization pattern (SW6 for R1) or (SW9 for R2) provided on the Slave A PCB Assembly
2. Enter the off-line mode using Dip switch SW5 (R1) or SW8 (R2).
   Set Bit 7 to ON.
   Depress the RESET switch.
   Set Bits 2 thru 6 to the ON position.
   Change over Bit 8.-Operation is started.
3. Observe LEDs D9 and D10 for R1, and LEDs D17 and D18 for R2. If either of the LEDs are flashing change the position of Dip switch SW6 for R1 or SW9 for R2 Bits 1 and 2 so that the LED's do not flash. When all the LED's are on, the setting is complete.
   Dip switches and LEDs correspond as follows;
   R1 SW6 bit 1 LED D9
   R1 SW6 bit 2 LED D10
   R2 SW9 bit 1 LED D17
   R2 SW9 bit 2 LED D18

4. Change over SW5 (R1) or SW8 (R2) Bit 8. Insure that the reagent arm is stopped in the home position and LEDs D9 and D10 or D17

and D18 are ON. If LEDs are flashing repeat the procedure. If LEDs are ON the magnetization pattern is set correctly.

5. If necessary change the label on the CPU Box front cover to reflect the correct settings for Dip switch SW6 (R1) or SW 9 (R2).
6. Reset Dip Switch SW5 (R1) or SW8 (R2) to the default positions.

5. Reset operation

1. Set Dip Switch SW5 (R1) or SW8 (R2) on the Slave A CPU PCB as follows.
Check and see that Bit 7 is set to the on position. (Now, the off- line mode is selected.)
2. Depress the reset switch.
3. Change over Bit 8 . Depress the reset switch, reset operation.
(The reset command specifies that Bit 7 exclusively should be set to the on position, all other bits off).
4. After that, change over Bit 8 to reset the unit.

6. Adjusting the Vertical position of the probe.

1. Perform the reset operation. (See section 5)
2. Enter the Off-Line Mode SW5 (R1) or SW8 (R2) Bit 7 ON, and depress Reset switch.
3. Move the R1 probe arm to the cuvette.
   Set SW5 bit 4 to ON
   Change position of SW5 Bit 8. (Start the operation).
   Move the R2 probe arm to the cuvette.
   Set SW8 bit 1 and 4 to ON
   Change position of SW8 Bit 8. (Start the operation).
4. The distance from the top face of the cuvette holder to the tip of the probe should be 11.1±0.2mm.
5. If height adjustment is necessary, loosen the 2 allen screws securing the arm to the vertical shaft. Loosen the height adjustment screw locking nut and adjust the height adjustment screw until the distance between the tip of the probe and the cuvette holder top face is 11.1 ± 0.2mm. Tighten the height adjustment screw locking nut. Tighten allen screws securing arm to vertical shaft.
6. Reset Dip Switch SW5 or SW8 to default position.
7. After adjusting height perform probe horizontal alignments

7. Adjusting the Horizontal Arm position at cuvette

1 Insure the Reaction Disk is properly aligned prior to adjusting the reagent probe arm.
2. Enter the Off-Line Mode SW5 (R1) or SW8 (R2) Bit 7 ON, and depress Reset switch.
3. Move the R1 probe arm to the cuvette.
   Set SW5 bit 4 to ON
   Change position of SW5 Bit 8. (Start the operation).
   Move the R2 probe arm to the cuvette.
   Set SW8 bit 1 and 4 to ON

Change position of SW8 Bit 8. (Start the operation).

4. With the probe over the cuvette insure reagent probe is centered in the cuvette. If necessary loosen the 2 allen screws securing the arm to the vertical shaft. Rotate the arm until the probe is centered over the cuvette. Tighten the 2 allen screws securing the arm to the vertical shaft.
5. Reset Dip Switch SW5 (R1) or SW8 (R2) to the default positions.

Figure 4.6
Reagent probe alignment to cuvette

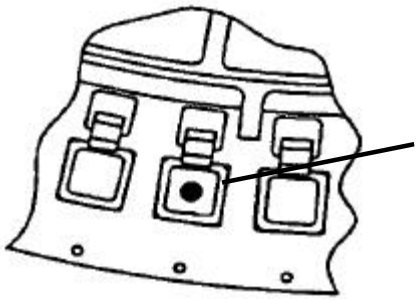
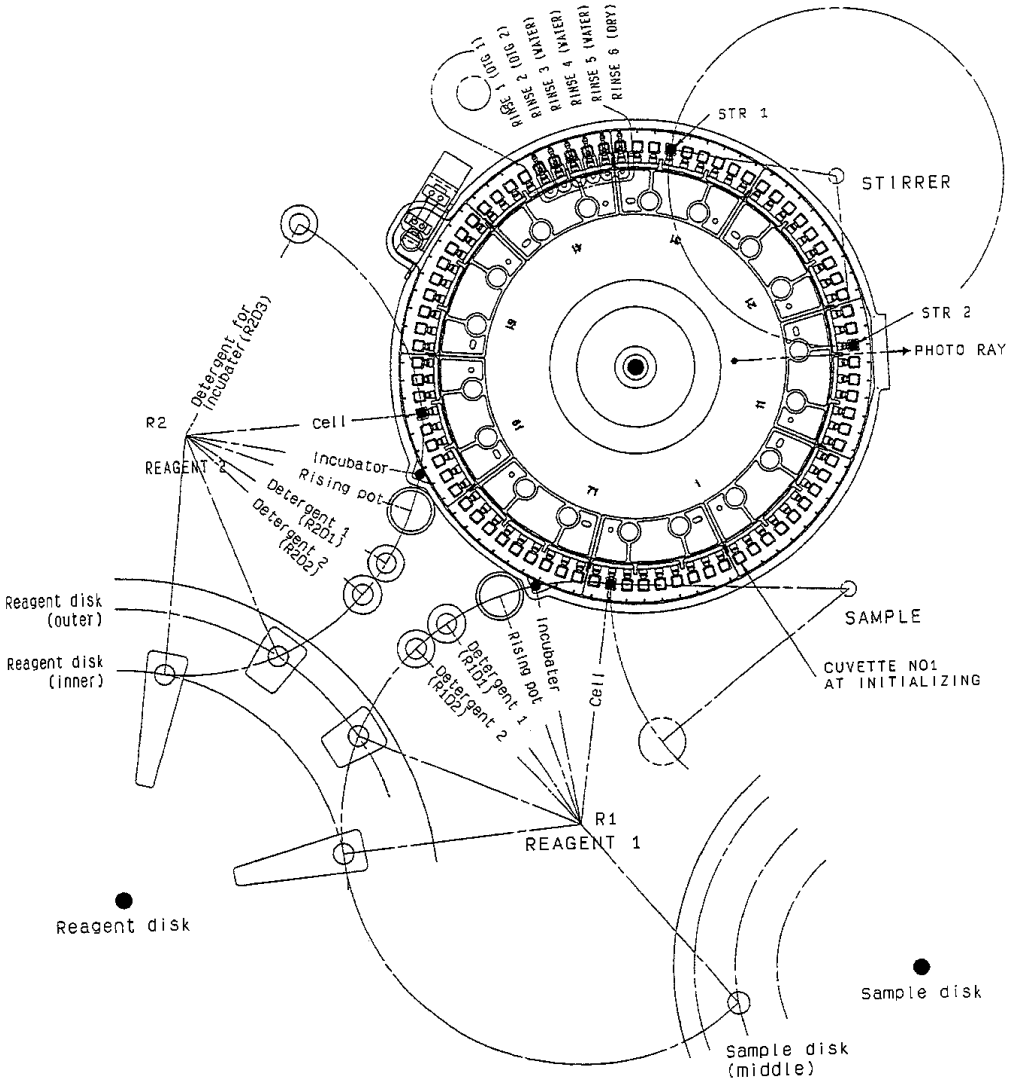


Figure 4.7
Reagent probe alignments



8. Adjusting the rinsing pot position

1. Move the probe arm to the rinsing pot position, in the off-line mode.
2. Enter the Off-Line Mode SW5 (R1) or SW8 (R2) Bit 7 ON, and depress Reset switch.
3. Move the R1 probe arm to the rinse pot.
   Set SW5 bit 2 and 4 to ON
   Change position of SW5 Bit 8. (Start the operation).
   Move the R2 probe arm to the rinse pot.
   Set SW8 bit 1, 2 and 4 to ON
   Change position of SW8 Bit 8. (Start the operation).
4. If necessary loosen the screws securing the rinse pot and adjust the rinse pot so that the probe is centered in the pot. (allowable error:±0.2mm). Tighten the screws securing the rinse pot.
5. Reset Dip Switch SW2 to the default positions.

9. Adjusting the reagent tray position

1. Move the probe to the reagent tray position in the off-line mode. (inner position)
2. Enter the Off-Line Mode SW5 (R1) or SW8 (R2) Bit 7 ON, and depress Reset switch.
   Set SW5 Bit 2, 3, and 4 to ON for R1.
   Change position of SW5 Bit 8. (Start operation)
   Set SW8 Bit 1, 2, 3, and 4 to ON for R2.
   Change position of SW8 Bit 8 . (Start operation)
3. The probe should be over the center of the inner reagent bottle position. If necessary adjust the Reagent Tray collar to align the tray with the probe.
   3.1 Reset the arm and remove the reagent tray.
   3.2 Loosen the 6 screws securing the reagent tray collar and adjust the tray as necessary.
   3.3 Tighten the 6 screws securing the reagent tray collar. Install the reagent tray.
   3.4 Repeat steps 1 and 2 above to confirm alignment of probe and reagent tray.
4. Verify alignment of the reagent probe for the outer positions. Repeat steps 1 and 2 above. Switch settings for SW5 (R1) and SW8 (R2) are as follows;
   R1 Outer Position SW5 bit 1, 3 and 4 to ON.
   R2 Outer Position SW8 bit 2, 3 and 4 to ON.
5. Reset Dip Switch SW5 or SW8 to the default positions.

10. Adjusting the Reagent detergent bottle positions.

1. The detergent bottles have two positions (1 holder) on the R1 side and three positions (2 holders) on the R2 side that require alignment.
2. Move the probe arm to the detergent bottle position, in the off-line mode.

3. Enter the Off-Line Mode SW5 (R1) or SW8 (R2) Bit 7 ON, and depress Reset switch.
4. Move the R1 probe arm to the detergent 1 bottle.
   Set SW5 bit 1, 2 and 4 to ON
   Change position of SW5 Bit 8. (Start the operation).
   Move the R2 probe arm to the detergent 1 bottle.
   Set SW8 bit 3 and 4 to ON
   Change position of SW8 Bit 8. (Start the operation).
5. If necessary loosen the screws securing the detergent bottle holder and adjust the holder so that the probe is centered in the bottle. (allowable error:±0.2mm). Tighten the screws securing the detergent bottle holder.
6 Check alignment of probes at the detergent 2 bottles. Follow steps 3 and 4 above using dip switch settings as follows.
   R1 SW5 Bit 3 and 4 to ON
   R2 SW8 Bit 1, 3 and 4 to ON
7 Check alignment of the R2 probe at the Incubator Detergent position. Follow steps 3 and 4 above using the dip switch settings as follows.
   R2 SW8 Bit 4 to ON
6. Reset Dip Switch SW5 or SW8 to the default positions.

11. Reagent arm encoder disk adjustment

The probe arm drive assemblies are identical (sample, R1 and R2) except for the encoder disks which control the stopping positions of the arms. If swapping/replacing of arm drive assemblies is required make sure that the correct encoder disk is used. Each encoder disk is identified by letter designations printed on the disk as follows:

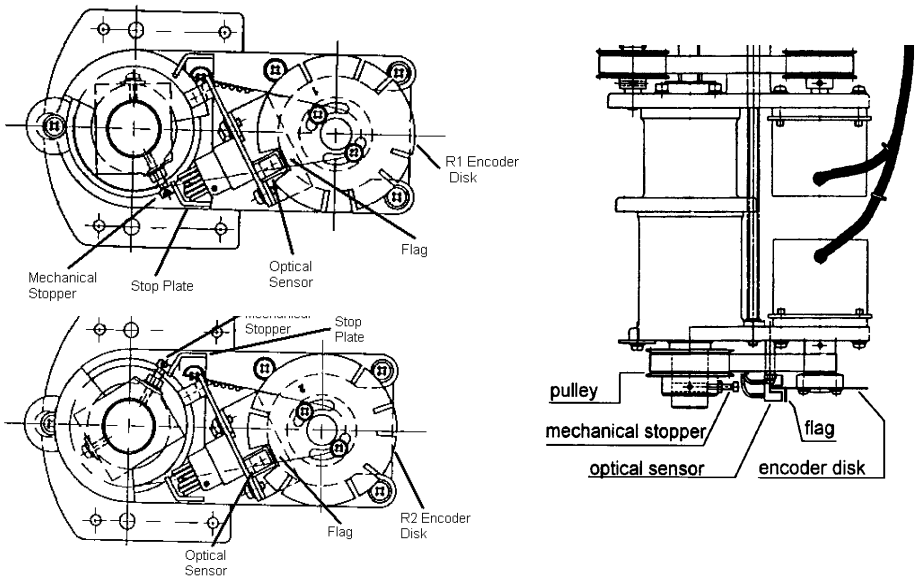
SP = Sample Pipette Arm Drive
1 = R1 Arm Drive
2 = R2 Arm Drive
ST = Stirrer Arm Drive

Encoder disks may be removed by removing the two fixing screws. If the encoder disk is removed the encoder disk alignment procedure must be performed.

Encoder Disk Alignment Procedure

1. Loosen the two fixing screws securing the reagent arm encoder disk to the hub.
2. Manually rotate the pulley counterclockwise for R1 or clockwise for R2 so that the mechanical stopper is against the stop plate. Refer to figure 4.8

Figure 4.8
Reagent arm encoder disk



3. With the mechanical stopper against the stop plate the flag on the encoder disk should be aligned (in line) with the optical sensor. If not rotate the encoder disk to align flag with optical sensor.
4. With the mechanical stopper against the stop plate and the flag aligned with the optical sensor tighten the encoder disk fixing screws.
5. After alignment of encoder disk perform the Electronic Home (Magnatization) procedure and the arm rotational alignment procedures.

4.3.3 Reagent syringe module

The reagent syringe module utilizes a positive displacement syringe for reagent volume metering.
The major components of the reagent syringe module are the reagent syringe body and plunger, stepper motor, solenoid valve, and connector pump pcb. Syringe module control is provided from the Slave “A” pcb and I/O Driver “B” pcb.

The stepper motor drives the syringe plunger via a flexible metal drive belt. An optical detector is used to sense the “Home Position” and for error detection. A mechanical stop is incorporated to prevent excessive drive in the event of a circuit failure. The solenoid valve directs liquid flow, ie. reagent aspiration and dispensing, diluent dispensing and probe rinsing. The pump connector pcb provides connections for the solenoid valve, stepper motor and interface to the I/O Driver “B” pcb.
The reagent syringe module is identical to the sample syringe module with the exception of the syringe body and plunger, and the home sensor flag.

The R1 and R2 syringe modules are identical and completely interchangeable.

There are no adjustments required on the syringe module.

4.4 Photometer/Reaction Disk

The reaction disk and photometer assemblies provide the analyzer a method to receive a sample and reagent and measure at a precise time and wavelength .

4.4.1 Analytical cycle description

The photometer adopts the reaction cell direct photometry method. The reaction disk turns by 40+1 cells in 1 cycle (9 sec). During this period the absorbance of the reaction cells travelling through the optical axis of the photometer is measured if requested at that time through the system programming. During measurement timing, a reaction cell is measured 33 times (33 data points) at the normal reaction time of 9.6 minutes, or 74 points in the 2 point reaction round analysis for 21.8 minutes.
The photometer adopts the after-spectrometry method. The white light emitted from the quartz lamp is focused through a lens. This passes through the reaction cuvette and is focused through a second lens and presents itself through a slit to be separated by the concave defraction grating. The holographic grating separates each wavelength and displays it across the photo detector array assembly. Each waveform is received at the same time by the detector, which the 12 photodiodes, at specific wavelengths are housed. This measurement is amplified and A/D converted so that the absorbance or difference in the absorbance can be obtained. Because the difference in the absorbance between two wavelengths is obtain in two wavelength photometry ,errors such as suspension in the sample, hemolysis, icterus, etc and fluctuations in the power supply can be compensated. This results in a stable photometric reading.

4.4.2 Mechanical cycle

The Photometer provides 12 channels (12 wavelengths) to measure at, enabled by the 16-bit A/D converter.
One cycle is 9 seconds and the cell disk rotates clockwise 1 complete rotation in 2 cycles. (18 seconds)
Photometry is performed for 40 + 1 cells in 1 cycle. (9 seconds)
Photometry is performed 144 times (12 wavelengths x 12 readings) for each cell per cycle. As the reaction disk rotates through the optical axis of the photometer, the cell blank and absorbance of the reaction solutions are measured. From the measurement of the data obtained by the 12 readings, for each wavelength , the lower 8 points are used

for the calculations, and the highest 4 points are discarded. The mean value of the lower 8 points is calculated and is the output data, of that cell, at that wavelength, for that data point. This is the value that is sent to the System PC via the main CPU, and is treated as 1 data point of the time course.
For each cell, data acquisition is performed over the entire reaction process, (33 data points) which takes approximately 9.6 minutes. The system parameters determine what wavelength and data points to use for the analysis.

Specifications :

Photometer	: Concave holographic grating
Wavelength	: 12 types that are fixed 340, 375, 405, 450, 510, 546, 570, 600, 660, 700, 750, 850.
Wavelength precision	: ± 3 mm
Light source	: Halogen lamp (12VDC, 20 W)

The Reaction disk is a single unit assembled with 9 sections. The nine sections house 81 reaction cuvettes. The cuvettes are individually removable and can be replaced as such. The nine sections may be replaced if needed. The reaction disk is removed as a single assembly by moving the screw cap. Care should be taken to avoid damage to the glass cuvettes.

Specifications :

Reaction period	: 9.75 min. (usually) : 21.8 min. (in case of 2- reaction round analysis)
Number of reaction cuvettes	: 81
Reaction disk	: 9 sectors holding 9 cuvettes
Cuvette cell size	: ID 5 x 5 x 32.2 (mm)
Reaction cell optical path length	: 5 mm
Cuvette materiel	: Pyrex glass
Minimum reaction volume	: 180 µl
Maximum reaction volume	: 500 µl
Cuvette replacement	: Each cuvette can be replaced independently
Cell water filling	: By setting the analysis environments, the cell can be filled with water after analysis

The reaction disk moves clockwise by 40 cells, approximately (4 sec.), stops (approximately 2 sec.), moves by 1 cell and stops (approximately 3 sec) in every cycle which is approximately 9 seconds. The reaction disk repeats this intermittent movement.
The reaction cuvette used in analysis is rinsed by the rinsing unit, and used repeatedly. The reaction cells should be removed as a complete

assembly. By loosening the retaining cap by hand, the reaction disk can be pulled upward and off of its drive assembly. Pay rigid attention when handling the reaction disk and the reaction cells so that the inner and outer surfaces are not damaged.

4.4.3 Photometer check-out and adjustments

1. Adjusting the photometer drive assembly

1. Adjust the motor attachment position so that the backlash of the gear becomes 0.1 to 0.3 mm in the outer of the drive gear.
2. Turn the drive gear quietly 10 turns by hand, feel the assembly while turning that it drives smoothly. If turning becomes heavy, or catches midway, adjust the motor attachment again or replace the part.
3. Tighten the drive gear. By hand, turn the motor damper quietly 5 or 6 times to make sure that it turns smoothly.

2. Check items before turning on power

1. Rotate the rotor while the reaction disk is removed and make sure no tubing, cables, etc., will interfere with its movement.
2. Make sure that the cuvette holder is correctly secured to the reaction disk. If deformed replace assembly.
3. Make sure that no foreign objects are present in any of the sectors. Check to see that the photo sensors are not obstructed in any way. Re-install the disk and tighten by hand. Turn the disk and see that it turns smoothly. Make certain that no part of the disk comes in contact with the walls of the incubator and also has no contact with any of the sensors.

3. Sensor check out , Power on

1. Turn on the power, and select sensor check in the off line mode using Dip Switch SW6 on the Slave B PCB assembly.

Set SW6 Bit 7 to the ON position.
Depress the RESET switch.
Set SW6 Bits 4,5,6, to the ON position.
Set SW6 Bit 8, to the ON position. (start operation)

2. Check the sensor status of the LED's to verify the sensors are operating properly. Refer to the sensor table. (figure 4.7)
3. Reset SW6 to the default positions.

4. Setting the magnetization pattern in adjusting the Reaction Module.

a. This is not required to perform.

5. Reset operation

1. Set the Dip switch SW6 on the Slave B CPU PCB as follows. Check and see that Bit 7 is set to the on position. (Now, the off-line mode is selected.)
2. Depress the reset switch.
3. Change over SW6 Bit 8 . Depress the reset switch, reset operation. The reset command specifies that Bit 7 exclusively should be set to the on position.)
4. After that, change over Bit 8 to reset the unit.

6. Adjusting the Reaction disk position

CAUTION:
Never perform the reset operation while the alignment pin is inserted into the hole on the plate jig. Otherwise, the alignment pin may become bent or damage to the cuvette holder may occur.

1. Remove the reaction disk (cuvette ring). Loosen the base/motor mounting screws in 3 positions and the photometer mounting nut.
2. Place the reaction disk back onto the mounting shaft. Place the collar and alignment plate jig onto the reaction disk shaft.
3. Perform the reset operation using the DIP Switch SW6 on the Slave B PCB assembly
4. Insert the alignment pin into the hole on the plate jig. Adjust the photometer so that the tip of the pin is inserted into the hole in the outer edge of the cuvette holder. Move the photometer slowly.
5. Remove the plate jig, collar and reaction disk. Tighten the base motor mounting screws and the Photometer mounting nut (loosened in step 1).
6. Place the collar, alignment plate jig and the reaction disk onto the shaft. Perform the reset operation. Insert the pin tool into the hole in the alignment plate and insure the tip of the pin tool is still aligned (inserted into hole in outer edge of reaction disk) with the hole in the outer edge of the reaction disk. Check the alignment at the remaining holes in the alignment plate jig.
7. Remove the pin tool. If the alignment is off repeat this entire procedure.
8. If alignment is good remove the collar and alignment plate jig. Reinstall the reaction disk.
9. After adjusting reaction disk verify all probe alignments (sample, R1, R2, stirrer, and rinse probes) and adjust if necessary.

4.5 Stirrers

The stirrer assembly mixes the reaction solution that has been dispensed into the reaction cells.

Specifications :

Stirrer method	: Stirring paddle method, stirring by up /down and rotational movement.
Stirrer timing	: Next cycle immediately after the reagent is dispensed.
First stirring	: 6.1 sec. after the 1st reagent probe dispenses reagent.
Second stirring	: 11.6 sec. after the 2nd reagent probe dispenses reagent.
Configuration	: The 1st and 2nd paddles are driven on the same arm.
Stirrer paddle turning	: Each of the 1st and the 2nd paddles turn independently.
Stirrer paddle drying	: After rinsing both paddles spin inside the vacant wash pots to remove any excess wash water.
Rinsing with detergent	: Rinsing the paddles with detergent 1 and 2 is available. The 2nd reagent probe dispenses the detergent into the reaction cell and this rinse is used by the paddles.

4.5.1 Stirring cycle description

When the first or second stirring paddle is requested, the stirring unit spins off excess water from both paddles. The stirrer paddle moves to a position above the reaction cuvette by the stirrer arm assembly. The stirrer unit moves down, then the requested paddle is activated and is exclusively rotated while the arm moves up and down in the cuvette to mix the solution. The stirring function, not only provides stirring by spinning the paddles, but also moves the unit up and down while inside the reaction cuvette. After stirring is completed the stirrer unit moves up and returns to the rinsing pot, then it is rinsed.

4.5.2 Stirrers check-out and adjustments

The stirrer assembly consist of the stirrer unit, which moves the paddles and the Slave B CPU, which controls the unit.

On the Slave B CPU dip switch SW3 is used to enter the Off-Line Mode, to perform checks and mechanical alignments. Return dip switch SW3 to the default positions after performing any procedures or checks.

1. Power on and sensor check

1. The arm drive module and the syringe module have already been adjusted into specification during assembly. When checking or

making adjustments take note of the positional relationship between the sensor and the light shielding plate.
2. Insure system power is on.
3. Select Sensor Check from the off-line mode using Dip Switch SW3 provided on the Slave B CPU assembly.
   Set Bit 7 to ON.
   Depress the RESET switch.
   Set Bits 1-6 to ON.
   Set Bit 8 to ON. (start operation)
   The sensor status is indicated by the LED's
   Check the LED Indication Table (4) Check Sensor, Stirrer/Rinse.
   Insure all sensors are operating correctly.
4. Reset dip switch SW3 to the default positions.

2. Setting the magnetization pattern

1. Set the magnetization pattern in the off-line mode using the Dip switch SW1 for saving the magnetization pattern provided on the lave B PCB assembly.
2. Enter the off-line mode using Dip Switch SW3.
   Set Bit 7 to ON.
   Depress the Reset switch.
   Set Bits 2 thru 6 to the ON position.
   Set Bit 8 to ON (start operation)
3. Observe LEDs D1 and D2. If either of the LEDs are flashing change the position of Dip Switch SW1 Bits 1 and 2 so that LEDs D1 and D2 do not flash. When all LEDs are on, the setting is complete. Dip Switch SW1 bit 1 corresponds to LED D1 and bit 2 corresponds to LED D2.
4. Change over SW3 Bit 8. while Bit 7 exclusively is set ON (all other bits OFF) Reset operation.
5. Make sure that the stirrer arm is stopped in the rinse position even if Bit 8 is repeatedly changed over and LEDs D1 and D2 are ON.
6 Reset dip switch SW3 to the default position

3. Reset operation

1. Set the Dip switch on the Slave B CPU PCB as follows. Check and see that Bit 7 is set to the on position. (Now, enter the off-line mode.)
2. Depress the reset switch.
3. Change over Bit 8 . Depress the reset switch, reset operation. (The reset command specifies that Bit 7 exclusively should be set to the on position.)
4. After that, change over Bit 8 to reset the unit.

4. Adjusting the vertical position of the stirrer arm.

1. Enter the off-line mode SW3 bit 7 to ON, and depress the reset switch.
2. Move the Stirrer arm to the cuvette position.
   Set SW3 Bit 1, 2 and 4 to ON.
   Change position of SW3 Bit 8 (start operation)
3. With the stirrer at the cuvette position the distance from the top face of the cuvette holder to the tip of the stirrer paddle should be 14.0 ±0.2mm.
4. If adjustment is necessary loosen the two allen screws securing the stirrer arm to the vertical shaft. Loosen the height adjustment screw locking nut and adjust the height adjustment screw until the distance between the paddle and the cuvette holder top is 14.0± 0.2 mm. Tighten the height adjustment screw locking nut. Tighten the allen screws securing the arm to the vertical shaft.
5. Reset dip switch SW3 to default positions.
6. After adjusting height perform arm rotational position alignments.

5. Adjusting the arm rotational position

1. Insure the reaction disk is properly aligned prior to adjusting the stirrer arm assembly.
2. Move the stirrer arm to the cuvette position in the off-line mode using SW3 on the Slave B CPU.
   SW3 Bit 7 to ON.
   Depress the Reset switch.
   Set SW3 bit 1, 2 and 4 to ON.
   Change position of SW3 Bit 8 (start operation)
3. With the stirrer arm over the cuvette insure that the Stirrer 1 paddle is centered in the cuvette. If necessary loosen the 2 allen screws securing the arm to the vertical shaft. Rotate the arm assembly until the Stirrer 1 paddle is centered in the cuvette. Tighten the 2 allen screws securing the arm to the vertical shaft.
4. After adjusting Stirrer 1 paddle insure that Stirrer 2 paddle is centered in the cuvette. If necessary loosen the 2 phillips screws securing the Stirrer 2 paddle plate to the arm. Adjust the plate until the stirrer 2 paddle is centered in the cuvette. Tighten the 2 phillips screws securing the Stirrer 2 plate to the arm.
5. Reset dip switch SW3 to default positions.

6. Adjusting the stirrer arm rinsing pot position

1. Move the stirrer arm assembly to the rinsing pot position in the off-line mode using the Dip Switch SW3 on the Slave B CPU.
2. Set dip switch SW3 bit 7 to ON.
   Depress the Reset switch.
   Set SW3 bit 1 and 4 to ON.
   Change position of SW2 bit 8 (start operation)
3. With the Stirrer arm over the rinse pots insure the paddles are centered in the pots. If necessary loosen the screws securing the rinse pots and adjust pots so that paddles are centered. Tighten screws securing the rinse pots.

3. Reset SW3 to default positions.

7. Stirrer arm encoder disk adjustment

The probe arm drive assemblies are identical (sample, R1 and R2) except for the encoder disks which control the stopping positions of the arms. If swapping/replacing of arm drive assemblies is required make sure that the correct encoder disk is used. Each encoder disk is identified by letter designations printed on the disk as follows:

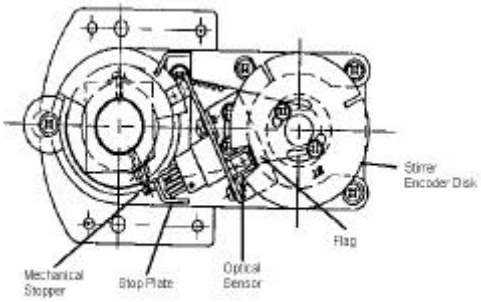
SP = Sample Pipette Arm Drive
1 = R1 Arm Drive
2 = R2 Arm Drive
ST = Stirrer Arm Drive

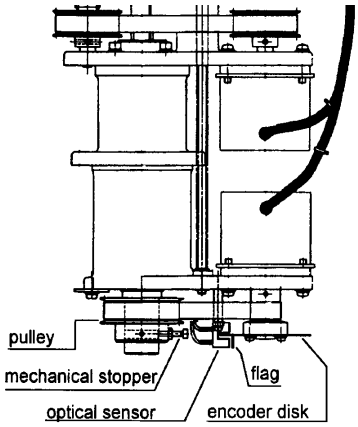
Encoder disks may be removed by removing the two fixing screws. If the encoder disk is removed the encoder disk alignment procedure must be performed.

Encoder Disk Alignment Procedure

1. Loosen the two fixing screws securing the stirrer arm encoder disk to the hub.
2. Manually rotate the pulley counterclockwise so that the mechanical stopper is against the stop plate. Refer to figure 4.9

Figure 4.9
Stirrer arm encoder disk





3. With the mechanical stopper against the stop plate the flag on the encoder disk should be aligned (in line) with the optical sensor. If not rotate the encoder disk to align flag with optical sensor.
4. With the mechanical stopper against the stop plate and the flag aligned with the optical sensor tighten the encoder disk fixing screws.
5. After alignment of encoder disk perform the Electronic Home (Magnatization) procedure and the arm rotational alignment procedures.

4.6 Cuvette wash station

The cuvette wash station is used to aspirate the reaction solution, wash and dry the reaction cuvettes to prepare them for the next analysis cycle. After the analysis, the cell rinsing unit aspirates the reaction solution, rinses the reaction cell with detergent, rinses the reaction cell with water, supplies and aspirates the water for cell blanking and dries the reaction cell.
Each probe is manufactured into 2 sections. One section aspirates a solution and the other section supplies a solution. This provides a means to clean the reaction cuvettes. Six probes are housed in the arm assembly, each probe is spring loaded and spaced precisely which allow the probes to enter individual reaction cells and perform their task. The spring loading allows the arm to reach the bottom of the cuvettes without breaking or causing any damage.

Specifications :

Rinsing probe type : Each single probe is divided into two (2) parts this provides twelve (12) separate functions. There are six (6) probes.

1A : Reaction solution aspiration	1B : Detergent 1/Rinse discharged
2A : Detergent 1/Rinse aspiration	2B : Detergent 2/Rinse discharged
3A : Detergent 2/Rinse aspiration	3B : Rinse water discharged
4A : Rinse water aspiration	4B : Cell blank water discharged
5A : Rinse water aspiration	5B : Cell blank water discharged
6A : Drying probe aspiration	6B : Drying probe rinse water

Rinsing with detergent : The rinsing probes 1 and 2 are provided with diluted detergent in which they discharge into the reaction cuvettes to rinse them with.
Cell 1 detergent : New Acid S detergent.
Cell 2 detergent : New Alkali S detergent.

4.6.1 Cuvette washing cycle description

During analysis, the reaction disk moves by 40 cells, stops, then moves by one cell and stops in every 9 sec. cycle. The reaction disk repeats this intermittent operation. The cell rinsing unit rinses the reaction cell once by one down and up operation in the first stop and also twice by two down and up operations in the second stop.(Total 3 times, all in one cycle.)
The rinsing process for one reaction cell is started when the cell rinsing unit performs the second down and up operation. The reaction cell is rinsed with the detergent 1 (3 times), detergent 2 (3 times) and water (9 times), then it is dried twice.

1. Reaction cell 1 moves and stops.

a. 1A reaction solution aspirated, 1B detergent 1 discharged b. 1A detergent 1 is aspirated, 1B detergent 1 discharged.
2. Reaction disk moves 40+1cell, detergent 1 storing and rinse.
3. Reaction disk moves 40 cells and stops.
   a. 1A detergent 1 is aspirated, 1B detergent 1 discharged.
4. Reaction disk moves 1 cell and stops.
   a. 2A detergent 1 aspirated, 2B detergent 2 discharged.
   b. 2A detergent 2 aspirated, 2B detergent 2 discharged.
5. Reaction disk moves 40+1 cell, detergent 2 storing and rinsing.
6. Reaction disk moves 40 cells and stops
   a. 2A detergent 2 aspirated, 2B detergent discharged.
7. Reaction disk moves 1 cell and stops.
   a. 3A detergent 2 aspirated, 3B water discharged.
   b. 3A water aspirated, 3B water discharged.
8. Reaction disk moves 40+1 cell, water storing and rinsing.
9. Reaction disk moves 40 cells and stops.
   a. 3A water aspirated, 3B water discharged.
10. Reaction disk moves 1 cell and stops.
   a. 4A water aspirated, 4B water discharged.
   b. 4A water aspirated, 4B water discharged.
11. Reaction disk moves 40+1 cell,1st cell blank measured.
12. Reaction disk moves 40 cells and stops.
   a. 4A water aspirated, 4B water discharged.
13. Reaction disk moves 1 cell and stops.
   a. 5A water aspirated,5B water discharged.
   b. 5A water aspirated,5B water discharged.
14. Reaction disk moves 40+1 cell, 2nd cell blank measured.
15. Reaction disk moves 40 cells and stops.
   a. 5A water aspirated, 5B water discharged.
16. Reaction disk moves 1 cell and stops.
   a. 6A water aspirated.
17. Reaction disk moves 40+1 cell and stops.
18. Reaction disk moves 1 cell and stops.
   a. 6A dewaters cuvette.

4.6.2 Cuvette wash station check -out and adjustment

The cuvette wash station module is really made up of three modules. The rinsing module houses the aspiration and discharge probe assemblies, six combination probes in all. This module provides vertical and rotational movement.
The Drain pot assemblies, these provide a controlled vacuum source to aspirate solution out of the reaction cuvettes to a drain source.
The Detergent dilution assembly provides a source to draw detergent 1, detergent 2, or degassed water and discharge this into the cuvettes for rinsing.
The Slave B PCB controls these assemblies.

The Slave B PCB controls both the rinsing module and the stirrer module. When turning on power, perform the initial adjustment of the stirrer module first if this has not been done.

1. Adjusting cuvette vertical drive

1. Move the vertical shaft up and down before turning on the power. This also can be done after power is on if you are in the off-line mode and magnetization is turned off. Confirm that it moves smoothly.
To disable magnetization (motor power) use the dip switch SW3 on the Slave B CPU.
Set Dip Switch SW3 Bit 7 to ON.
Depress the Reset switch.
Set SW3 bit 3 to ON.
Change position of SW3 bit 8 (start operation)
Set SW3 to default positions when procedure is completed.
2. Adjust the module so the top face of the light shielding plate becomes flush with the top face of the upper photo sensor when the shaft is moved up until it reaches the upper stop position. Upper mechanical stop is set to 23.4 mm. Adjust the module also so the bottom of the light shielding plate becomes flush with the bottom of the lower photo sensor when the shaft is moved down and reaches the lower stop position. Lower mechanical stop is set to 23.3 mm.

2. Adjusting the rinse probe

1. Move the rinsing probe up and down by hand, make sure that they move smoothly.
2. Make sure that the rinsing probes (6 total) spring back to their upper limits when pulled down by hand and released.
3. Make sure they are all straight and enter the reaction cuvettes without striking the sides, this excludes the drying tip which should slide smoothly down the cuvette wall.

3. Turning on the power and checking the sensors

1. This procedure places the instrument in the off line mode to provide sensor checking.
2. Turn on the power. Locate the Dip Switch SW3 on the Slave B PCB.

Set Bit 7 to the ON position.
Depress the reset switch.
Set Bits 1 to 6 to the ON positions.
Set Bit 8 to the ON position.

3. The sensor status is displayed by the LED indication. Check the LED indication table (4) Check Sensor Stirrer / Rinse. Insure all sensors are operation correctly.
4. Reset dip switch SW3 to default position.

4. Adjusting the backlash of the drive gear

Move the shaft up and down while the motor is energized and adjust the motor mounting screws if necessary so that the play between the gears becomes no more than 0.1 to 0.3 mm. Make sure that grease is applied to the engaged portions of the gear.

5. Vertical drive adjustment

1. Loosen the set screw to the collar assembly, move the collar up and down and adjust and fix the collar so that the distance between the tip of the rinsing probe and the top face of the cuvette holder is 6.5±0.2 mm.

6. Confirming the backlash of the drying tip

1. Check the backlash of the Teflon drying tip and that it is within the set range of 0.2 to 0.5mm. If not the dispersion of the cuvette cannot be handled.

7. Plane position adjustment

Place the instrument in the off line mode to make these adjustments. Before performing this procedure check the reaction disk and verify that it is in its proper alignment.

1. This procedure places the instrument in the off line mode and removes power to the motor.
2. Turn on the power. Locate the Dip switch SW3 on the Slave B PCB. Set Bit 7 to the ON position.
   Depress the reset switch.
   Set Bits 1 to 6 to the ON positions.
   Set Bit 8 to the ON position.
   The sensor status is displayed by the LED indication. Check the LED table to verify proper sensor status.
3. Set the movement in the vertical direction, and adjust the plane position and the rotation position.
4. Loosen the screw, adjust six probes so that all of them can be inserted without touching the cuvette, then tighten the screw again.

5 Fluidics

5.1 Pure Water supply

The pure water system provides water for washing the outside of the probes and stirrer paddles at their wash stations. It is also a supply source to the degassed water system. See Fig.5.1

5.1.1 Pure water description

The main task of the pure water system is to supply water to the analyzer at a constant pressure adjusted to 90 +/- 5 Kpa. This utilizes a feed tank, a water level sensor, solenoid valves, a distribution manifold and pressure pump. The distribution manifold routes the supplied water to the degasser water system and to the wash pots, it also supplies the ISE module. The system provides draining and refilling of the feed tank for maintenance routines.

The water enters the analyzer through a general water filter located out side the instrument. Through the inlet port the pure water flow is controlled by SV 71. From SV 71 the water enters the feed tank through the Float Switch assembly. The feed tank provides the system with a constant supply of pure water and a place to detect water levels needed for general operation of the analyzer. The Float Switch incorporates three floats. They detect the various levels of pure water in the tank and alert messages to the System PC. When the top and middle floats are in the up position SV 71 is closed which stops filling the pure water tank. When the top and middle floats are in the down position SV 71 is opened which allows water to fill the pure water tank. When all three floats are in the down position the error “Pure Water Tank Abnormal Level” is generated.

The pure water leaves the tank assembly via a snap connector at the bottom which supplies a pump . The pump assembly generates a constant pressure to the pure/degassed water manifold for distribution throughout the analyzer. See Table 5.1

Table 5.1

Manifold connections	Description
ISE Module	Used for probe washing.
Feed tank	Feed back loop to maintain constant pressure while. conserving its water requirements.
Pressure switch	Alerts the system if the water press becomes too low.
Pressure gauge	Pressure gauge displays the water pressure at the manifold assy. With the manifold regulating valve, (Red Handle) this should be adjusted to 90±5 kPa.
Degasser	Degasser provides degassed water back to the manifold for distribution with in the Degassed water system. (Explained later)
Solenoid valve 71 (SV71)	Allows pure water to fill the feed tank when requested by the feed tank level sensor switch.
Solenoid valve 72 (SV72)	Allows the analyzer to drain the feed tank assy for routine maintenance programs.

Pure water is routed to the Valve Pure Water Solenoid Manifold assy and is distributed to the systems probe and stirrer rinse pots which wash the outside of those assemblies. See Table 5.2

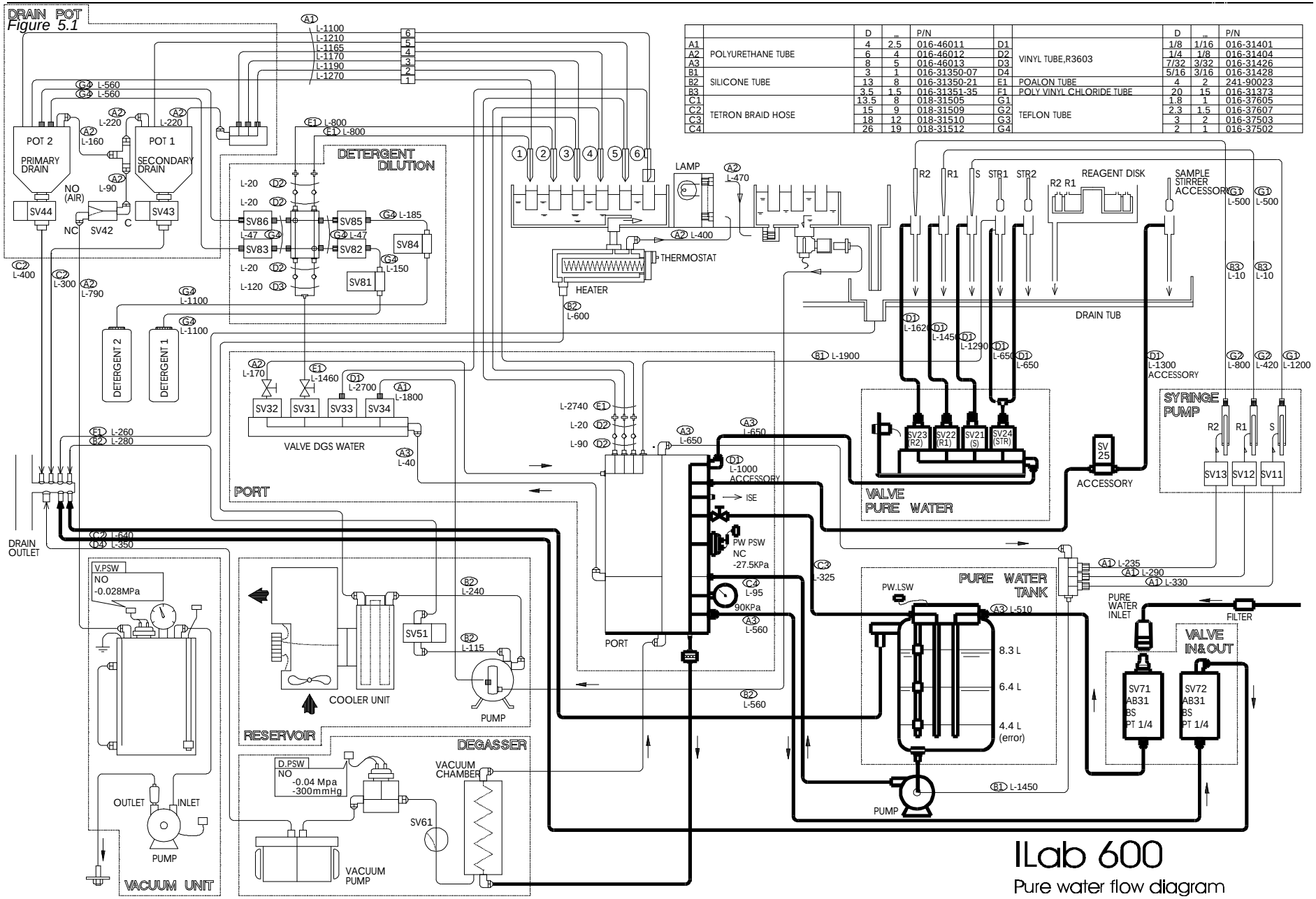
Table 5.2

Manifold connections	Description
Solenoid valve 21 (SV21)	Controls water to the sample rinse pot.
Solenoid valve 22 (SV22)	Controls water to the R1 rinse pot.
Solenoid valve 23 (SV23)	Controls water to the R2 rinse pot.
Solenoid valve 24 (SV24)	Controls water to stirrer 1&2 rinse pots.
Solenoid valve 25 (SV25)	Controls water to the sample stirrer rinse pot.

5.2 Degassed water supply

Degassed water is produced in the analyzer to provide the system with a source of gas free water which does not interfere with the photometric reading. This is needed to clean the cuvettes, rinse the sample and reagent probes internally, provide the system with a diluent source and a means to incubate the cuvettes while measuring through them. See fig.5.2

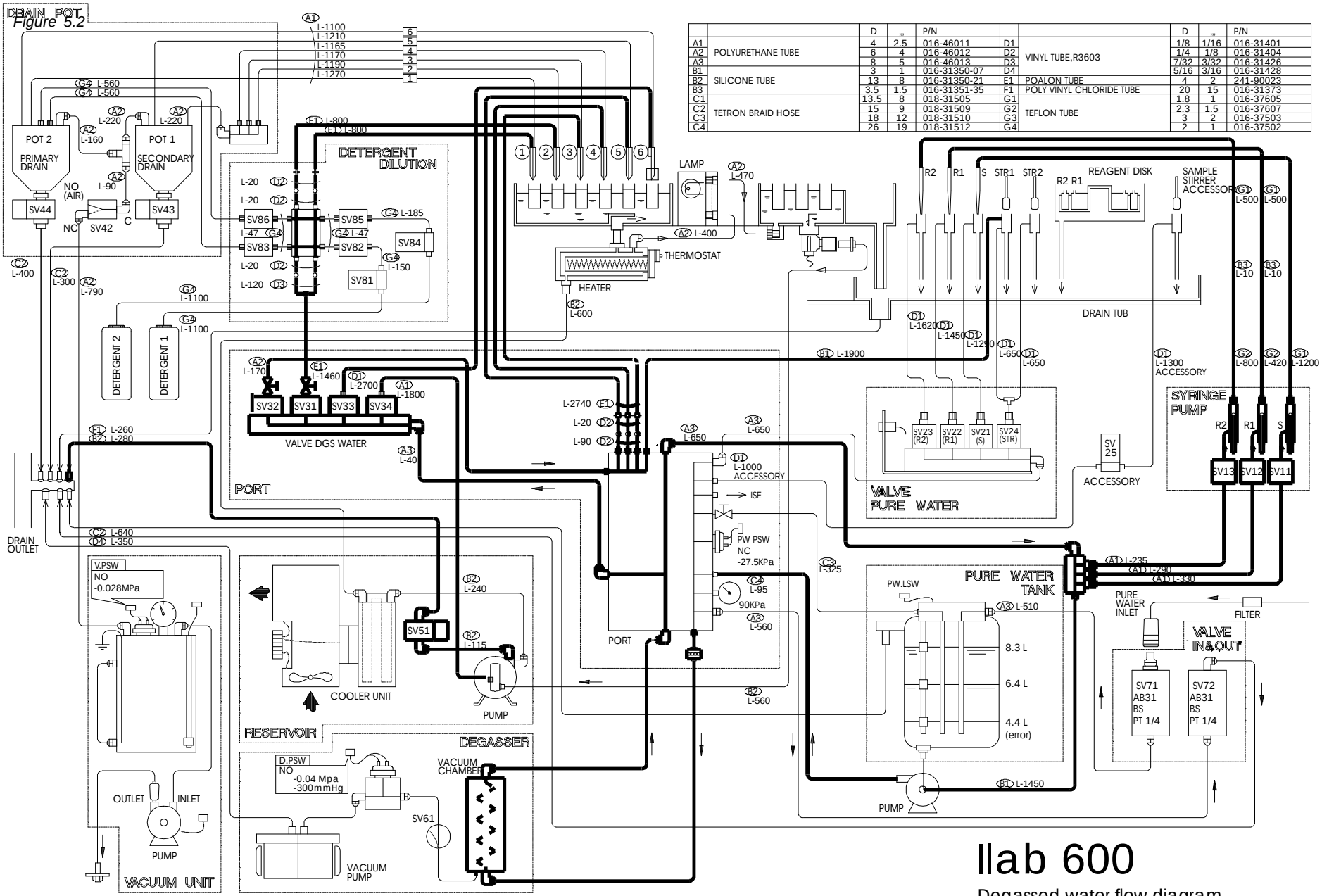
Figure 5.1



		D	⎓	P/N			D	⎓	P/N
A1	POLYURETHANE TUBE	4	2.5	016-46011	D1	VINYL TUBE,R3603	1/8	1/16	016-31401
A2		6	4	016-46012	D2		1/4	1/8	016-31404
A3		8	5	016-46013	D3		7/32	3/32	016-31426
B1	SILICONE TUBE	3	1	016-31350-07	D4		5/16	3/16	016-31428
B2		13	8	016-31350-21	E1	POALON TUBE	4	2	241-90023
B3		3.5	1.5	016-31351-35	F1	POLY VINYL CHLORIDE TUBE	20	15	016-31373
C1	TETRON BRAID HOSE	13.5	8	018-31505	G1	TEFLON TUBE	1.8	1	016-37605
C2		15	9	018-31509	G2		2.3	1.5	016-37607
C3		18	12	018-31510	G3		3	2	016-37503
C4		26	19	018-31512	G4		2	1	016-37502

Figure 2.

Figure 5.2



		D	⎓	P/N			D	⎓	P/N
A1	POLYURETHANE TUBE	4	2.5	016-46011	D1	VINYL TUBE,R3603	1/8	1/16	016-31401
A2		6	4	016-46012	D2		1/4	1/8	016-31404
A3		8	5	016-46013	D3		7/32	3/32	016-31426
B1	SILICONE TUBE	3	1	016-31350-07	D4		5/16	3/16	016-31428
B2		13	8	016-31350-21	E1	POALON TUBE	4	2	241-90023
B3		3.5	1.5	016-31351-35	F1	POLY VINYL CHLORIDE TUBE	20	15	016-31373
C1	TETRON BRAID HOSE	13.5	8	018-31505	G1	TEFLON TUBE	1.8	1	016-37605
C2		15	9	018-31509	G2		2.3	1.5	016-37607
C3		18	12	018-31510	G3		3	2	016-37503
C4		26	19	018-31512	G4		2	1	016-37502

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Degassed water flow diagram

5.2.1 Degassed Water fluidic description

Pure water is supplied and passes through the Degasser unit. This has a membrane inside which the water passes by on one side and on the other side is a vacuum. The membrane has the ability to let gas pass through but not a liquid, in turn this draws the gas out of solution and leaves the water gas free.

The degassed water leaves the Degasser and is routed to the pure water/ degassed water manifold. The manifold routes the degassed water to several selected areas of the analyzer. See table 5.3

Table 5.3.

Manifold connections	Description
Syringe Pump assy	Supplies water to the syringe pump assy.
Solenoid valve (SV11)	Controls the flow to the sample syringe.
Solenoid valve (SV12)	Controls the flow to the R1syringe.
Solenoid valve (SV13)	Controls the flow to the R2 syringe.
Valve degass water manifold	Supplies water to Solenoid valves SV31,SV32,SV33,SV34.
Solenoid valve (SV31)	Controls the flow to the detergent module and probes 1-2.
Finger valve /(SV31)	Adjust the flow to Probes 1, 2.
Solenoid valve (SV32)	Controls the flow back to the module and probes 3-5.
Finger valve /(SV32)	Adjust the flow to Probes 3,4 and 5.
Solenoid valve (SV33)	Controls the flow to probe 6 the drier.
Solenoid valve (SV 34)	Controls the flow to the incubator bath pump.
Solenoid valve (SV51)	Controls the degas system to drain.

Degassed water is routed from the pure water/degassed water manifold to the degassed water valve assy. The degassed water valve assy consists of solenoid valves SV31-34.

SV31-33 control water flow to the wash probes. SV31 controls water flow to wash probes 1 and 2. SV32 controls water flow to wash probes 3, 4 and 5. The flow from SV31 and SV32 is adjustable. Finger valves mounted on top of these valves are used to increase or decrease the volume of water delivered to the cuvettes during the wash routine. Also a vent line is routed to STR Pot 1 to relieve back pressure.

SV33 feeds water to wash probe 6 (dryer tip). Flow from SV33 is fixed by the hardware and is not adjustable.

SV34 supplies degassed water to the incubator/reservoir assy. As DGS water enters the pump it is circulated out of the pump and into the cooler unit. This assists in maintaining constant temperature in warm environmental conditions. The DGS water leaves the cooler unit and is routed to the heater assy. Here it is heated and maintains as requested a constant temperature. The incubator bath circulates the water around the cuvettes and the Quartz lamp assy. SV51 is used to drain the water bath assy and degassed water system.

Degassed water is also routed to the syringe pumps via SV11-13 for internal rinsing and as a means of providing a diluent.

5.3 Vacuum fluidics

The main task of the vacuum system is to provide a source of vacuum for the Degasser assembly, draw in detergent 1-2 to assist in cleaning of the cuvettes and to evacuate the cuvettes in their wash cycles.

5.3.1 Vacuum fluidic description

The vacuum system is comprised with two pumps. The first pump pulls a vacuum on the Degasser assy and the second pump pulls a vacuum on the main vacuum tank. The vacuum generated is used by demand and is cycled by the system for degassing and is vented to the drain outlet.

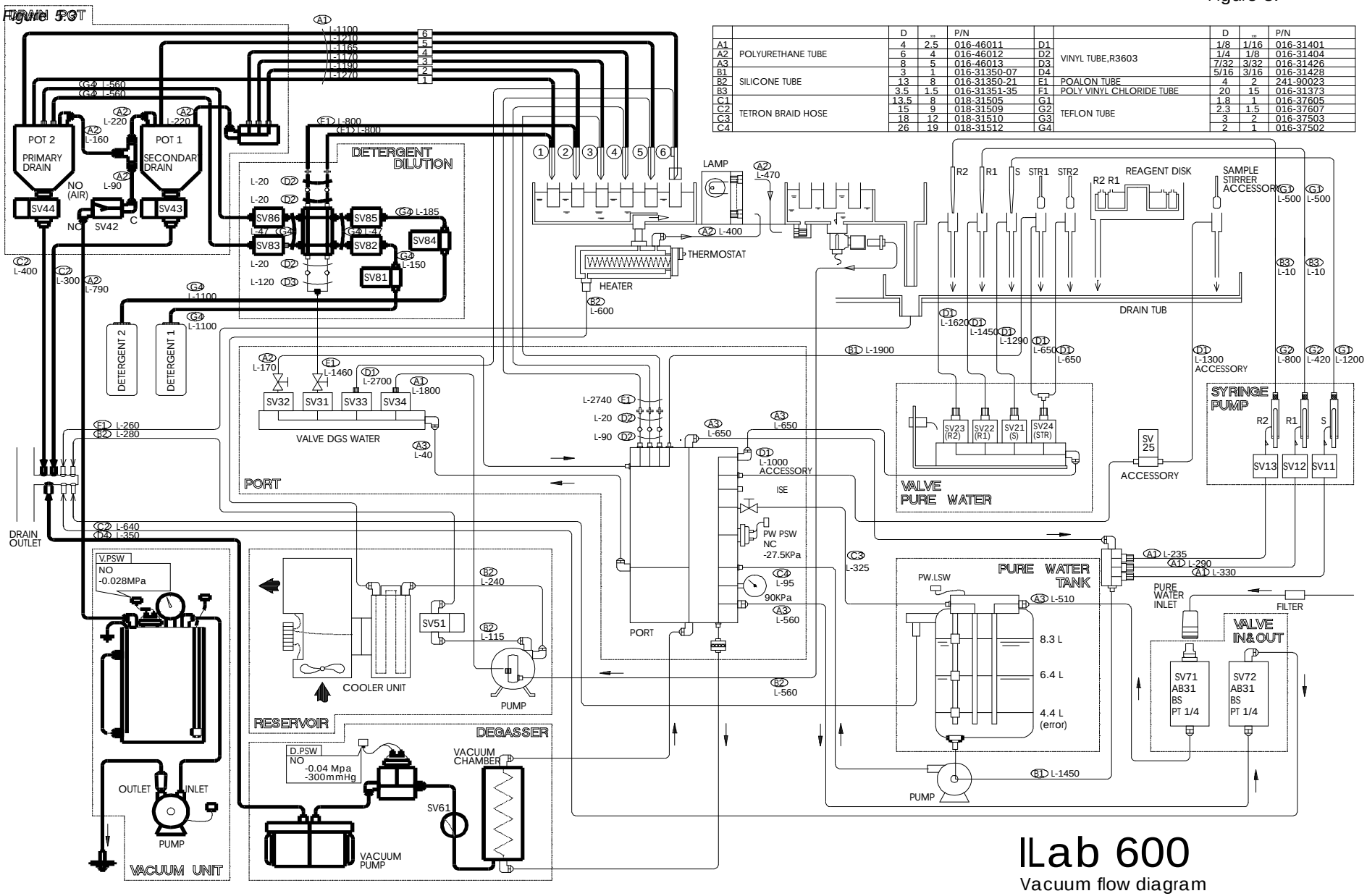
The second pump supplies a source for the Drain Pot assy and the Detergent Assy .The main vacuum tank is pulled down in vacuum by the main vacuum pump. The vacuum gauge should indicate -0.075 Map or less. A higher reading may indicate a leak in the system.

The tank assy also incorporates a float switch which provides overflow protection. The vacuum sensor transducer supplies error detection to the System PC.

The main source is routed to the Drain Pot assembly.

The Drain Pot assy provides the analyzer with the ability to evacuate the cuvettes during its cleaning cycle and introduce a vacuum pull for detergent 1 and 2 into the Detergent Dilution chamber. See table 5.4

Figure 3.



		D	...	P/N			D	...	P/N
A1		4	2.5	016-46011	D1		1/8	1/16	016-31401
A2	POLYURETHANE TUBE	6	4	016-46012	D2	VINYL TUBE,R3603	1/4	1/8	016-31404
A3		8	5	016-46013	D3		7/32	3/32	016-31426
B1		3	1	016-31350-07	D4		5/16	3/16	016-31428
B2	SILICONE TUBE	13	8	016-31350-21	E1	POALON TUBE	4	2	241-90023
B3		3.5	1.5	016-31351-35	F1	POLY VINYL CHLORIDE TUBE	20	15	016-31373
C1		13.5	8	018-31505	G1		1.8	1	016-37605
C2	TETRON BRAID HOSE	15	9	018-31509	G2	TEFLON TUBE	2.3	1.5	016-37607
C3		18	12	018-31510	G3		3	2	016-37503
C4		26	19	018-31512	G4		2	1	016-37502

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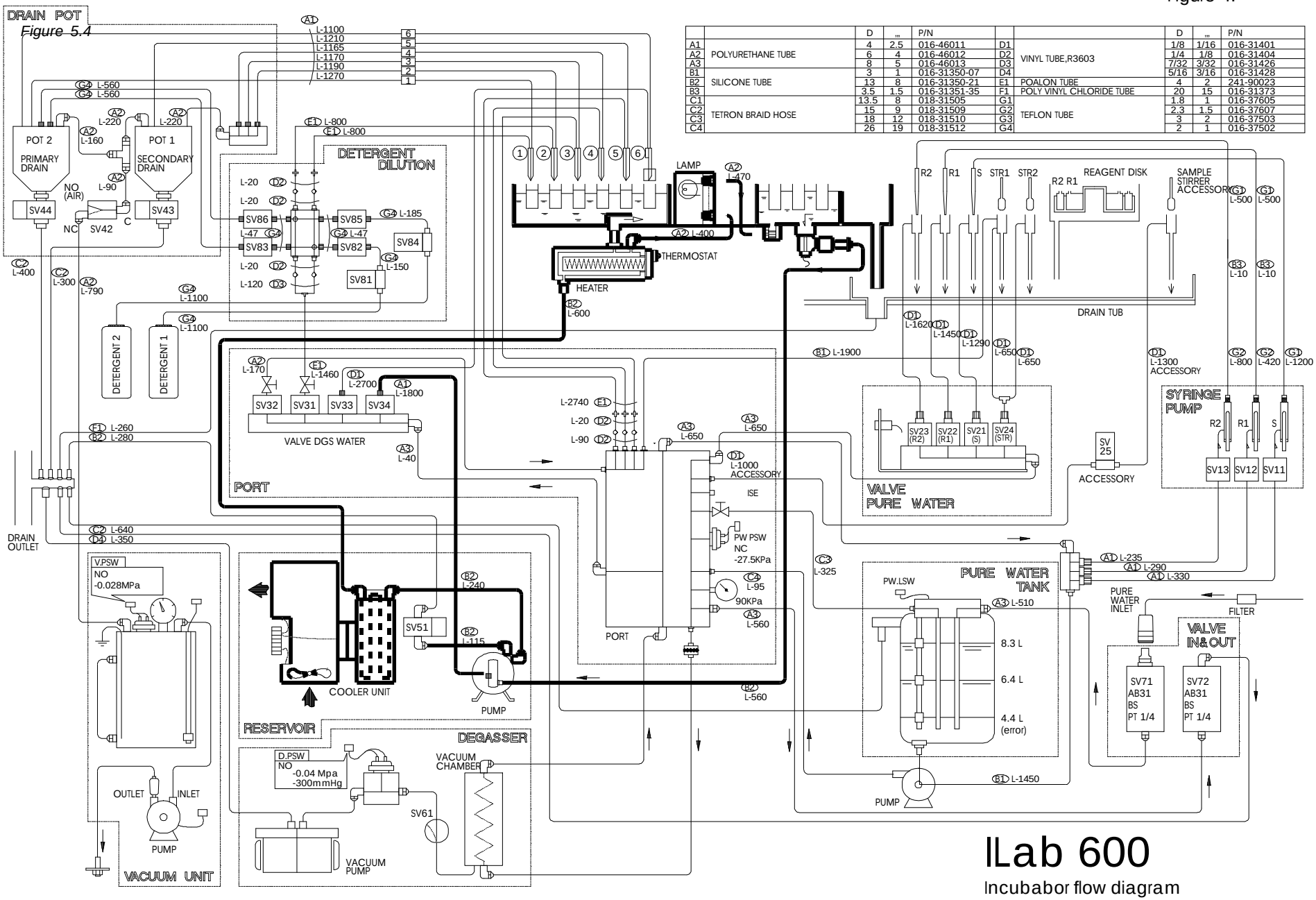
Vacuum flow diagram

Figure 4.

Figure 5.4



		D	,,,	P/N			D	,,,	P/N
A1		4	2.5	016-46011	D1		1/8	1/16	016-31401
A2	POLYURETHANE TUBE	6	4	016-46012	D2	VINYL TUBE,R3603	1/4	1/8	016-31404
A3		8	5	016-46013	D3		7/32	3/32	016-31426
B1		3	1	016-31350-07	D4		5/16	3/16	016-31428
B2	SILICONE TUBE	13	8	016-31350-21	E1	POALON TUBE	4	2	241-90023
B3		3.5	1.5	016-31351-35	F1	POLY VINYL CHLORIDE TUBE	20	15	016-31373
C1		13.5	8	018-31505	G1		1.8	1	016-37605
C2	TETRON BRAID HOSE	15	9	018-31509	G2	TEFLON TUBE	2.3	1.5	016-37607
C3		18	12	018-31510	G3		3	2	016-37503
C4		26	19	018-31512	G4		2	1	016-37502

lLab 600

Incubabor flow diagram

Table 5.4 .

Manifold connections	Description
Degasser	Used to draw gas out of water by membrane technology.
Degasser Manifold	Provides a connection from the pump to SV61,D.PWS and the degasser.
Degasser Pressure switch	Trigger alarm if vacuum is abnormal
Solenoid valve 61 (SV 61)	Vents vacuum pump
Vacuum gauge	Displays the vacuum in atmospheres at the vacuum tank assy.
Vacuum tank pressure switch	Alerts the system PC if the vacuum falls out of specifications -0.028Mpa.
Vacuum tank assy	Supplies the system with a constant vacuum source.
Float switch	Alerts the system PC if the vacuum tank is filling up with waste.
Solenoid valve 42	Controls vacuum to the primary/secondary drain and wash probes.
Solenoid valve 43	Controls venting and waste drain to Pot 2 Primary drain assy.
Solenoid valve 44	Controls venting and waste drain to Pot 1 Secondary drain assy.
Solenoid valve 81	Sets detergent volume
Solenoid valve 82	Open fluidic path to detergent
Solenoid valve 83	Prime detergent 1
Solenoid valve 84	Set detergent volume
Solenoid valve 85	Open fluidic path to detergent
Solenoid valve 86	Prime detergent 2
Solenoid valve 31	Controls cycles degassed water to mix with detergent for the wash probes.
Wash probes	Half of the wash probe assys provide vacuum draw to evacuate the cells.

5.4 Incubator Bath fluidics

The incubator Bath assembly provides the analyzer a means to heat reaction cuvettes to a constant temperature and allows the photometer to read the test through the degassed water

circulating around them. In this system a cooling unit has been installed to provide greater temperature stability in warmer environmental conditions. See Fig. 5.4

5.4.1 Incubator bath description

Sv34 controls the level of water in the bath assy, which is sensed by the bath level detector. As DGS water enters the pump it is pressurised and circulated into the cooler unit. The degassed water leaves the cooler unit and is routed to the heater assy. Here it is heated and maintains as requested a constant temperature. The water exits the heater and is pumped to the cuvette bath housing and the quartz lamp housing. In this area the water circulates around the cuvettes for incubation and the lamp for cooling. The bath level detector is located here and maintains the bath water to a constant level. When in contact with the water SV34 is closed, when not in contact with the water, the valve opens and adds water. A drain on the water bath allows the circulating pump to draw out the bath water. This is returned to the pump and the cycle starts over again. SV51 is used to drain the Degassed water system. See table 5.5

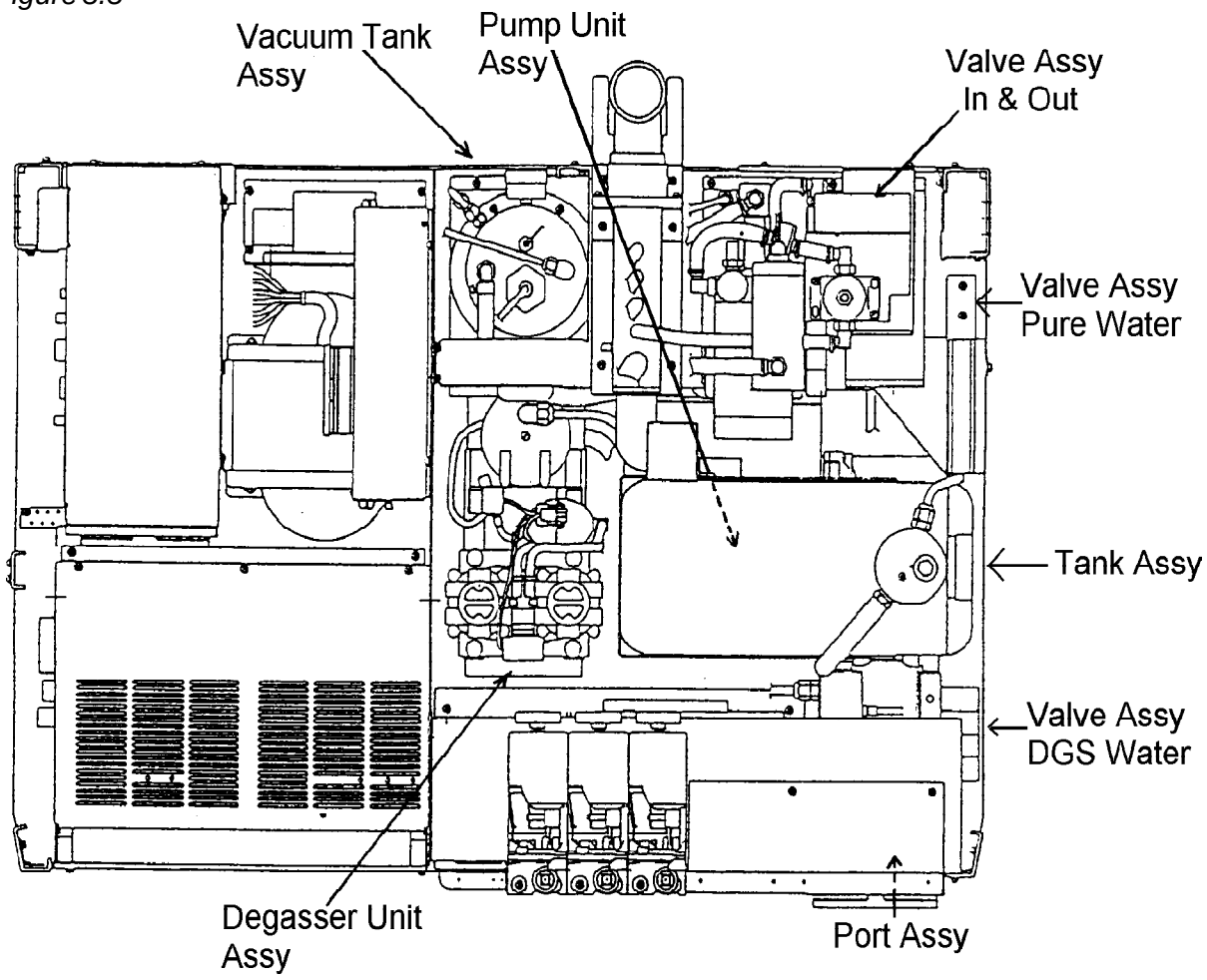
Table 5.5

Incubator connections	**Description**
Solenoid valve 34 (SV34)	Control the feed of water to the bath assy.
Pump	Provides circulation.
Cooler unit	Cools Bath and aids in thermal regulation.
Heater/Thermostat	Heats and regulates bath water.
Incubator Bath	Provides circulation of bath water around cuvettes for incubation.
Lamp housing	Cools the lamp, cancels lamp housing from affecting incubation.
Solenoid valve 51 (SV51)	Drain incubator system
Bath level sensor	Detects the level on bath water and controls SV34.

5.5 Check-out and adjustments

The following section will outline check outs and adjustment of the ILab 600 fluidic and vacuum systems.

Figure 5.5



5.5.1 Adjustment of Pure water pressure

Prior to adjusting the Pure Water Pressure the system should be in the Ready or Analyzing status. Insure the pump is operating properly and the pump fluid path has no air bubbles.

While observing the pressure gauge located on the manifold turn the regulating valve (red handle) to set the pressure to 90 ± 5 Kpa.

5.5.2 Adjustment of the cuvette washing flow rate

Select " Maintance " and "Rinse cells " or request a water blank to perform the next series of adjustments. After adjustments and checks have been made to the pure water system and are completed, perform the analysis operation by selecting " Maintenance" at the system PC.

Fig. 5.6

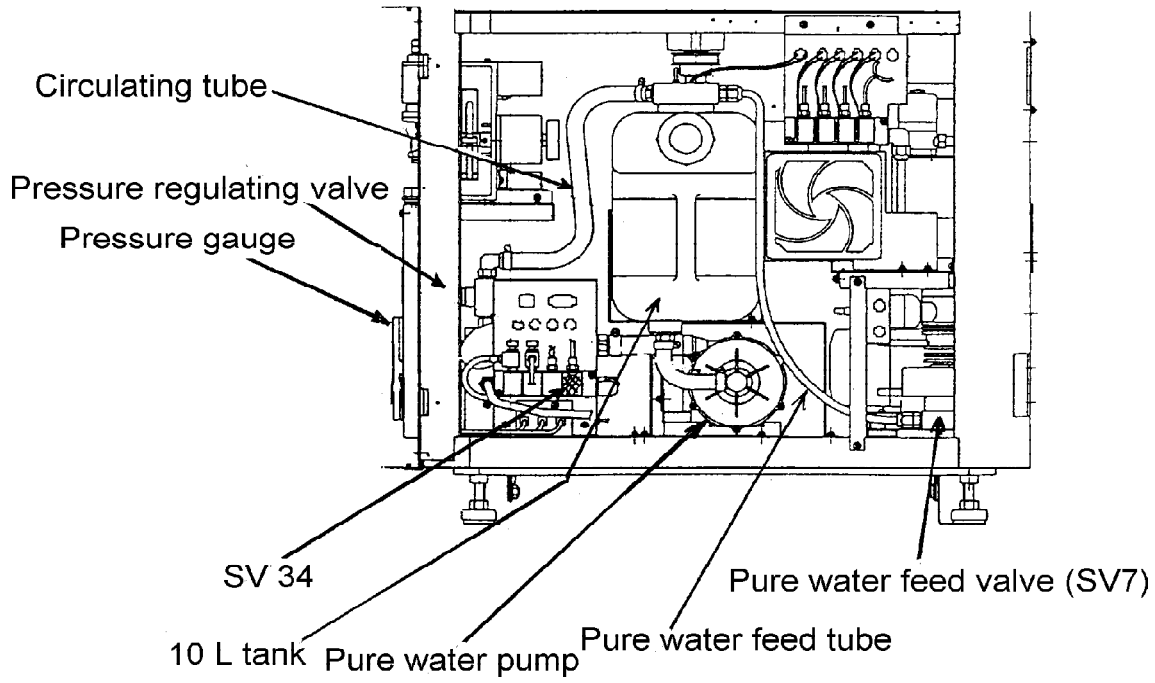

Circulating tube
Pressure regulating valve
Pressure gauge
SV 34
10 L tank
Pure water pump
Pure water feed tube
Pure water feed valve (SV7)

Fig 5.7

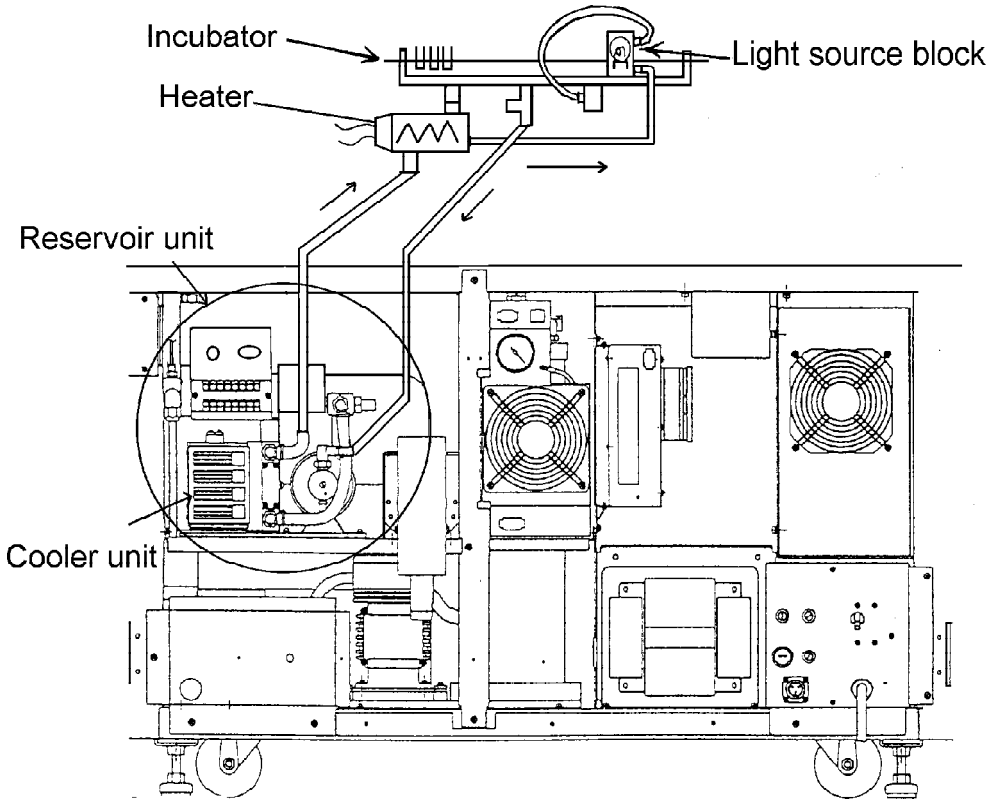
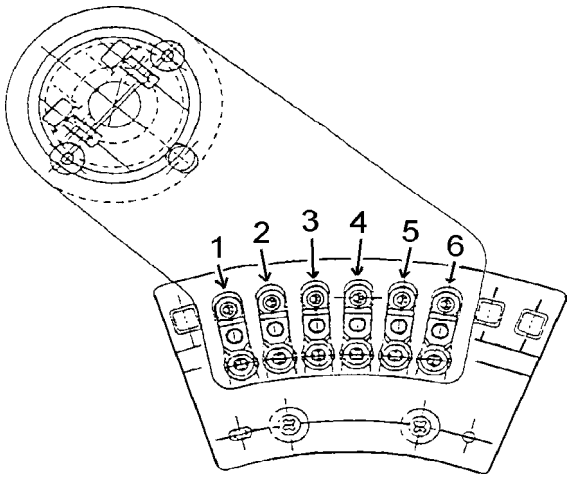
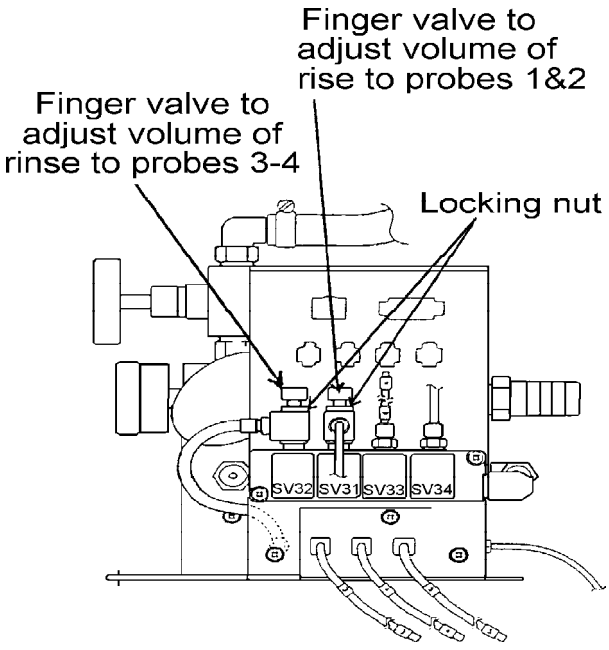

Incubator
Heater
Light source block
Reservoir unit
Cooler unit

Fig. 5.8



1. Adjusting the Flow rate for probes 1 and 2 is accomplished at SV 31. Locate SV31, sitting on top of the valve you will find the finger valve that controls the volume of water that is dispensed out of the probes and into the cuvettes.

Fig 5.9

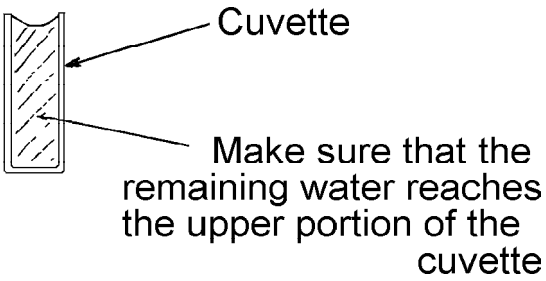


2. Observe the levels in the cuvettes. If adjustment is required , level to low or overflowing, loosen the locking nut to the valve.
3. Adjust the finger valve so the level is approximately 2 mm below the top of each cuvette and not overflowing. When

adjustment is complete, tighten down the locking nut.

4. Check to see flow stops as the cuvettes move and no dripping is seen from the tips of the probes. If dripping is observed then SV31 may need cleaning or replacement.
5. Adjusting the Flow rate for probes 3 and 5 is accomplished at SV 32.
6. Locate SV32, sitting on top of the valve is the finger valve that controls the volume of water that is dispensed out of the probes into the cuvettes there.
7. Observe the levels in the cuvettes. If adjustment is required, ie level too low or overflowing, loosen the locking nut to the valve.

Fig 5.10



8. Adjustment the finger valve so the level is approx 2 mm below the top of each cuvette and not over flowing. When adjustment is complete, tighten down the locking nut.
9. Check to see flow stops as the probes exit the cuvettes and that no dripping is seen from the tips of the probes. If so then SV32 may need cleaning or replacement.
10. The volume of water to probe 6 is provided by SV33. This is hardware determined and no adjustment is required. However, make sure the water fills the cuvette and does not overflow. A stuck or leaking valve may cause this. If so Sv33 may need cleaning or replacement.

5.5.3 Check-out of detergent dilution module

This procedure is intended to verify that the dilution manifold will draw in detergent 1 and detergent 2.

1. For testing place both detergent probes into distilled water.
2. From the System PC open up the “Maintenance” menu.
3. Select “H/W Maintenance “.
4. Next double click “Rinsing Nozzle”. Displayed on the screen, select “detergent charge 15 times” twice. This will prime the

Fig 5.11

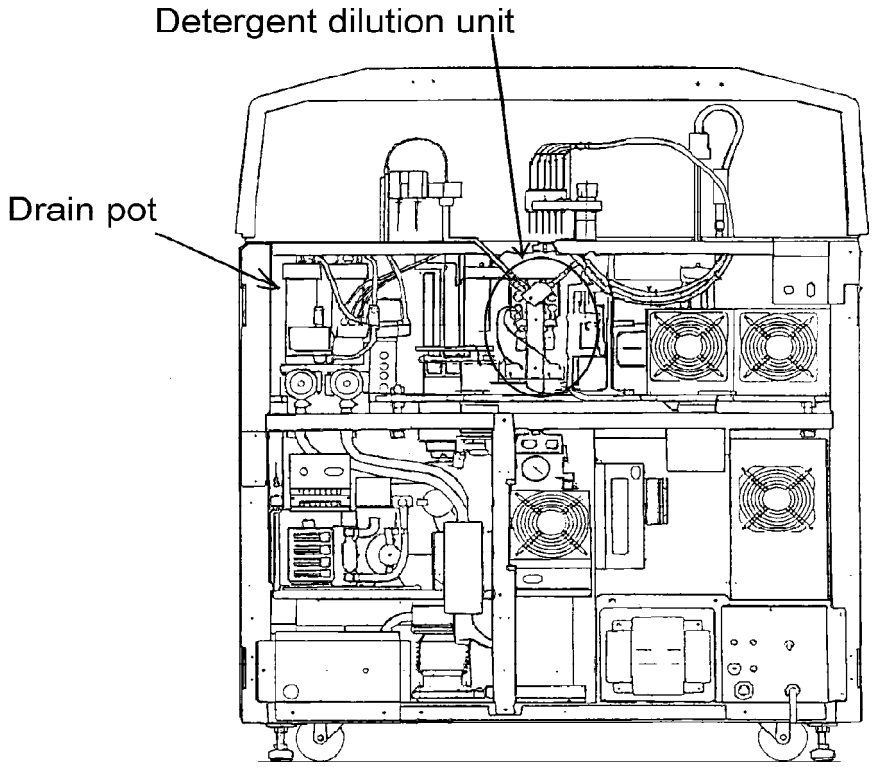
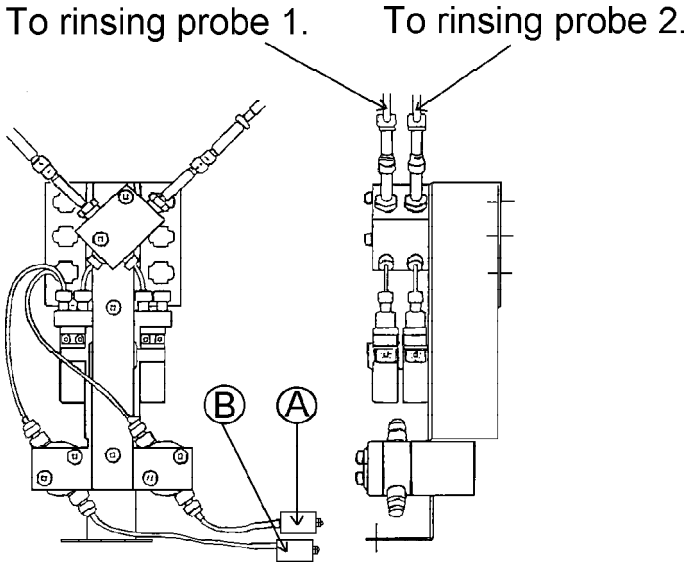


Fig 5.12



tubing and module with detergent. At this time observe the Drain Pots 1 and 2 and to verify that dispensing is taking place.

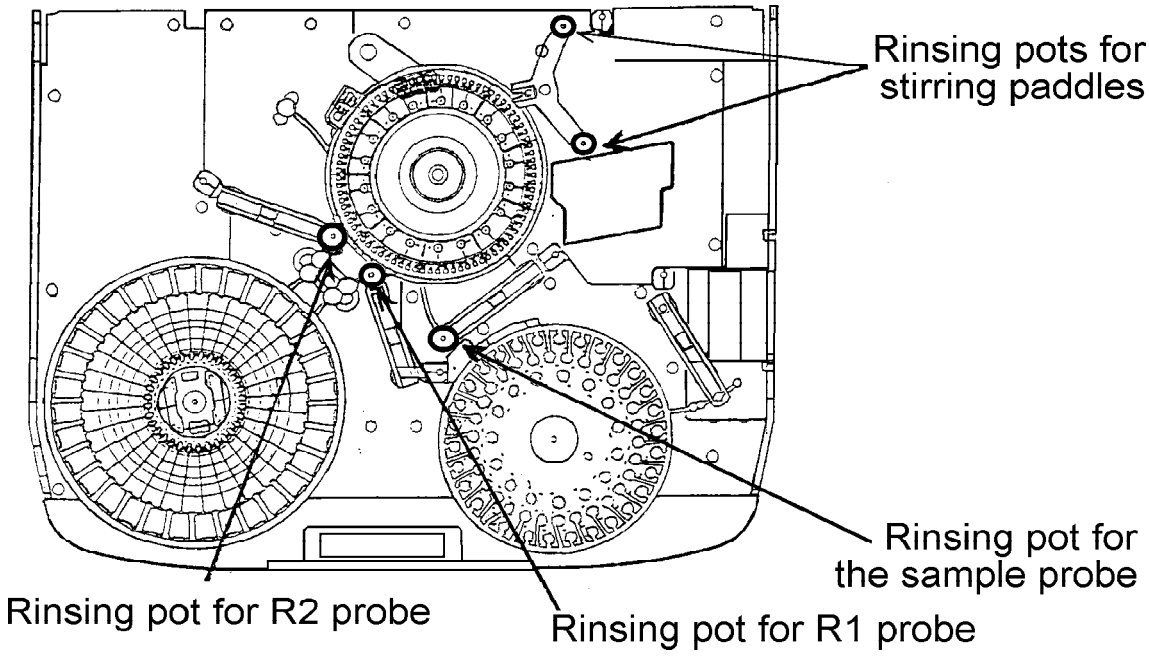
5. Next select in maintenance menu “Rinse the cell by simulation”.

6. Take the Detergent probes out of the bottles verify that the dilution action will draw an air bubble into the tubing.
7. Place the tubing back into the solution. Follow the air bubble and verify that each cycle moves it towards the manifold 12 to 20 mm. Observe this for both probe assemblies.
8. If the air bubble travel is out of specification (12 to 20 mm), adjust the detergen volume by the setting the screw located at the rear of SV 81 (detergent 1) and SV 84 (detergent 2). When adjusting detergent volume, the screw must be adjusted only while power for the valve is off; it is suggested to unplugging the valve connector for safety.
9. At this time check the tubing and the manifold module for any leaks.

5.5.4 Adjustment of the rinsing pot flow rate

The rinsing pots are used to provide wash to the outside of the probe and stirrer assemblies.

Fig 5.13

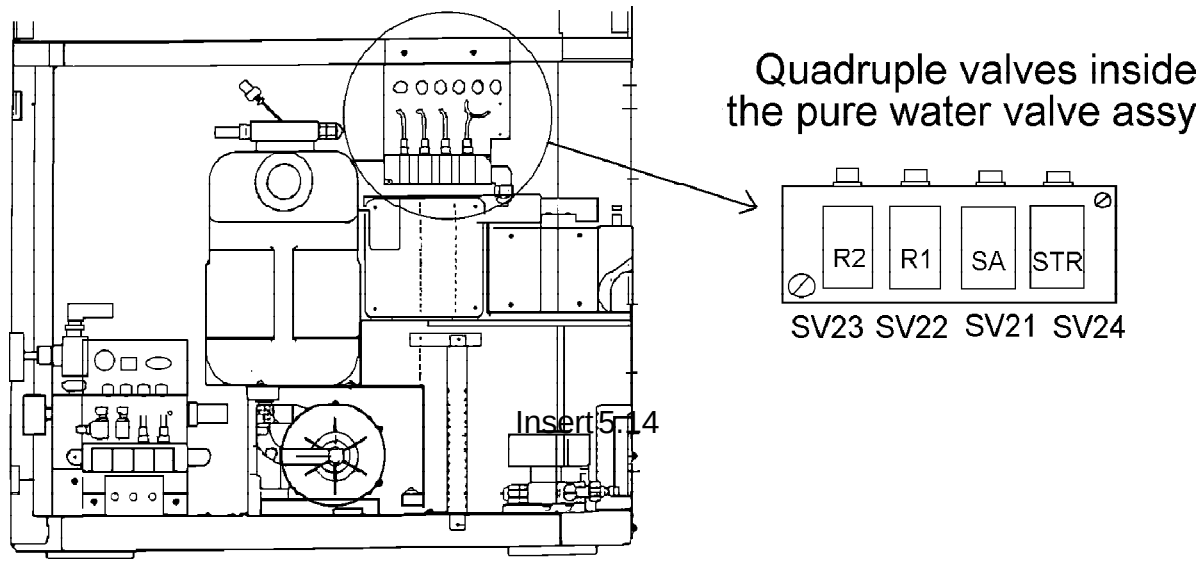


1. Verify that rinsing water is flowing to the Rinse Pot assemblies. These are used for the Sample and reagent probes, also stirrer 1, stirrer 2 and the sample stirrer assembly (the Sample stirrer is an option).
2. The volume of water to the Rinse Pot assembles are controlled and is adjustable by a adjustment screw at the pot assembly. This is only for the sample and reagent probe rinse pots.

Adjustment is not needed at the stirrer paddles (the adjustment screws are not provided).

3. When the system is in the ready state flow to the Rinse Pots should be off. If any of the pot are flowing the associated solenoid valve should be check, cleaned and if necessary replaced. See table 5.2.

Fig 5.14



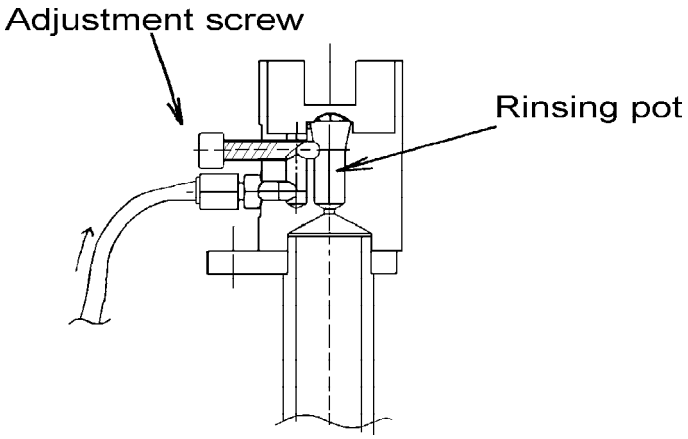
4. The Rinse Pots are adjustable by use of a thumb screw on the side of each assembly. The adjustment screw is manufactured with a diagonal taper to it, this will play in the adjustment. Tighten or loosen the screw .This will increase or decrease the flow rate. Adjust the flow of rinsing water just above its outlet so that the probes and stirrers are rinsed, but not to over flow the rinse pot. When you have reached this be certain that the taper faces downward in its direction. Once again the stirrer pots are without adjustment screws . Check to see that water does flow and reaches the upper area of the pot assy. If not, cleaning or replacement of the observed troubled rinse pots solenoid may be needed. See table 5.6

5. Check all tubing and connectors for any leaks.

Table 5.6

Manifold connections	**Description**
Solenoid valve 21 (SV21)	Controls water to the sample wash pot.
Solenoid valve 22 (SV22)	Controls water to the R1 wash pot.
Solenoid valve 23 (SV23)	Controls water to the R2 wash pot.
Solenoid valve 24 (SV24)	Controls water to stirrer 1&2 wash pots.
Solenoid valve 25 (SV25)	Controls water to the sample stirrer wash pot.

Fig 5.15



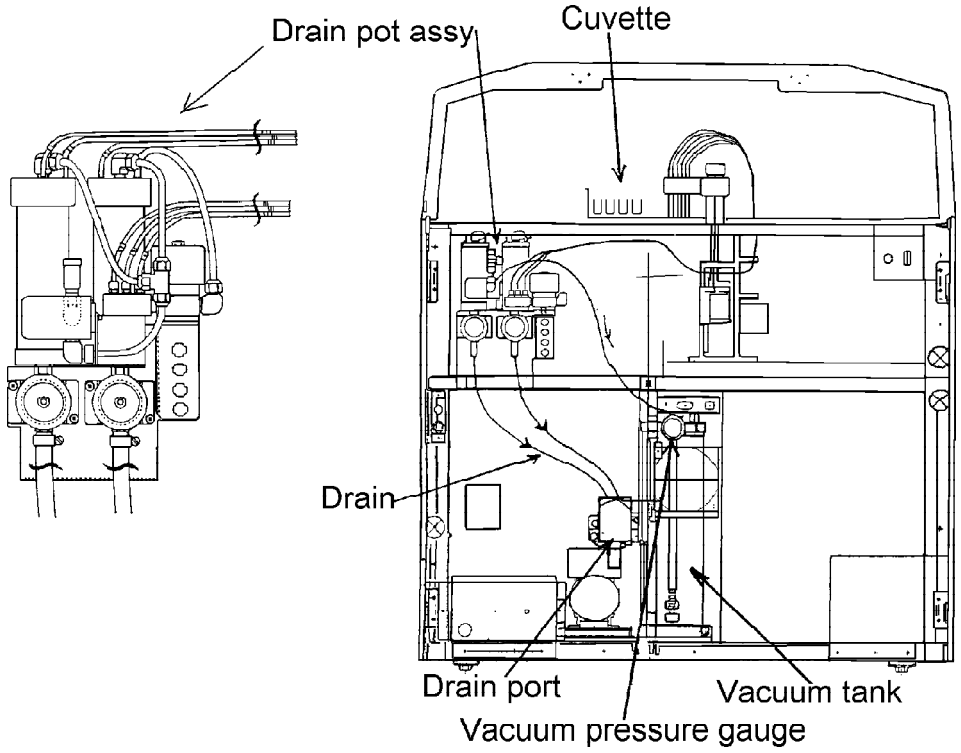
5.5.5 Check-out of the vacuum draining system

1. From the System PC "H/W Maintenance" menu select

   "Simulation"

2. Make certain that the vacuum setting during instrument operation is -0.03 to 0.08 Mpa.
3. Make certain that the flow from the cuvettes moves freely to the drain pots.

Fig 5.16



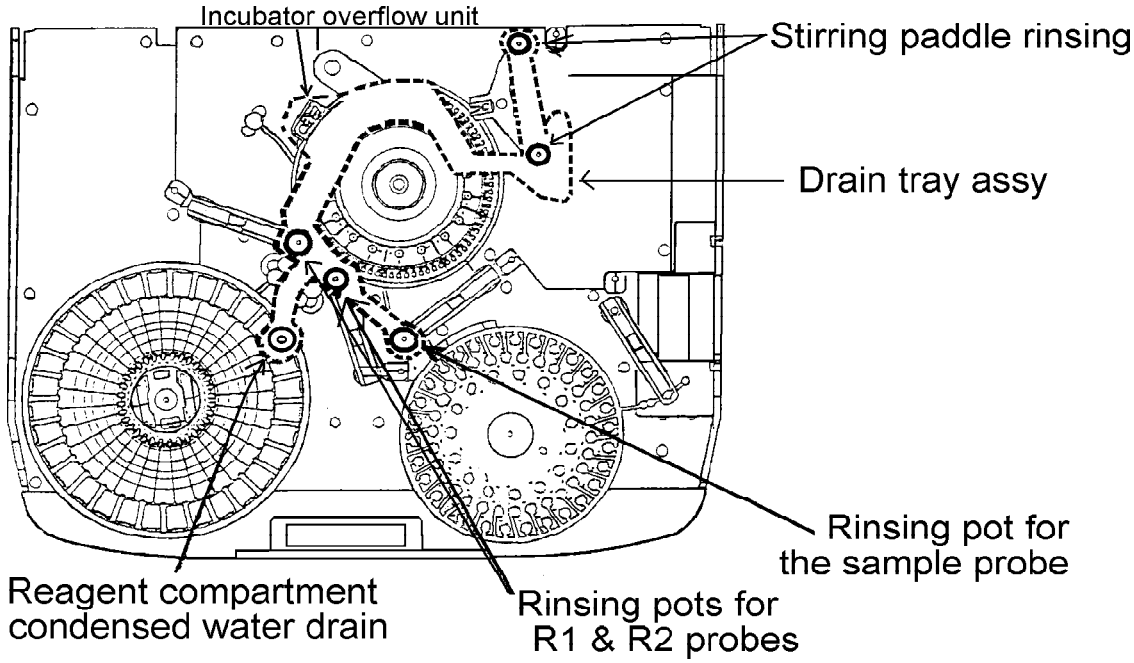
4. Make certain that the waste material that accumulates in the pots flow down and into the drain when SV42 is closed to the vacuum source and when SV43 and SV44 are opened to the drain outlet.
5. Check also that the waste flows to the drain and not back to the Vacuum Tank. If so SV 42 may need to be cleaned or replaced.

5.5.6 Check-out of the draining system

The drain system provides the analyzer the ability for access in water and waste removal. See fig. 5.17.

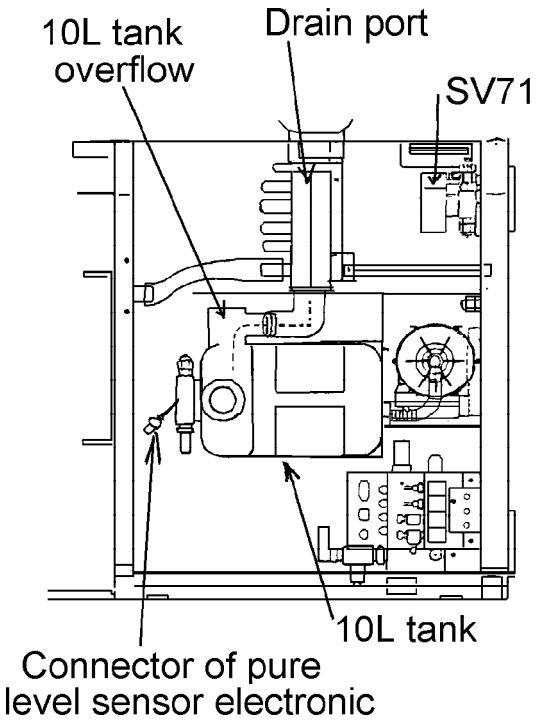
1. When the analysis operation is being performed, check the draining status from each rinsing pot. This includes sample, R1, R2, both stirrers and if installed the sample stirrer Rinse Pots.
2. Make certain that the drain flows smoothly into the drain tray and that the drain in the tray flows into the drain port without any overflow.

Fig. 5.17


Incubator overflow unit
Stirring paddle rinsing
Drain tray assy
Rinsing pot for the sample probe
Reagent compartment condensed water drain
Rinsing pots for R1 & R2 probes

3. Make certain that the drain from the tray doesn't splash. When the analysis operation stops, pour instrument grade, if possible degassed water from the upper portion of the cuvette incubator assembly. See that the water should enter the drain via the overflow that is provided and flows smoothly out the drain.
4. Check that the drains in the reagent and sample tray wells work properly.

Fig 5.18



5. Disconnect the connector of the pure water tank level sensor for the feed tank assembly. Feed water should continuously start to flow. Observe the feed tank overflow, make sure the overflow drains smoothly out of the tank and to the drain port, check for leaks. Reconnect the sensor assembly connector.
6. Check the incubator draining cycle and Pure Water feed tank draining cycle. This is done by programming the Start Up or Shut Down menus.
7. Replace the water in the incubator. Make certain that SV51 is opened and that the water in the incubator flows smoothly into the drain port. Check for leaks at this time.
8. Replace the feed tank water using the feed tank drain and replace program. Make certain that the tank empties smoothly into the drain port . Check for leaks at this time.

5.5.7 Bio-hazardWaste

The ILab 600 will come equipped with a bio-hazard waste removal system. This will allow the first wash station probe to draw contaminated sample out of the reaction cuvette and into a 20 litre waste container. The Bio-hazard waste assembly consists of a 20 litre container, container cap with float level detector and external drain hose. The drain hose is connected to the cap and the float level sensor cable is connected to the connector on the rear panel

of the ILab 600.

The waste evacuated from the cuvettes through rinse probes 1 and 6 is routed to the primary drain Pot 2. The outlet of Pot 2 is sent to the Bio-hazard waste container. When the liquid level in the waste container reaches approximately 17 litres the float sensor rises up and an alarm message " Waste Bottle Full" is displayed. This alarm will not inhibit system operation.

6 Temperature control

Temperature control is comprised of two systems. Control for the incubator (water bath) system and limited control for the reagent compartment.

6.1 Reagent compartment

The reagent compartment houses the reagent tray assembly. The tray incorporates 32 outer positions for 50 and 20 ml bottles and 32 inner positions for 100, 50, and 20 ml bottles.

There are two different types, the standard type and special type for the 100 , 50 and 20ml bottles. This makes six different combinations of bottles that can be utilized with the reagent tray.

The tray locks in place and is removable for cleaning or storage else where.

6.1.1 Hardware description

The reagent compartment includes, the housing, cooling devices and fans to provide air flow for the cooling units. The compartment is cooled to 5-15°C or 41-59°F, a cover is provided to maintain cooling and prevent dust from entering the compartment.

The temperature is maintained even if the main switch is turn off, the main breaker on the back of the analyzer will turn off power to the assembly.

6.1.2 Operating cycle

The Reagent Tray temperature is controlled by the DC Power pcb. Three thermal modules (peltiers) are used to cool the reagent tray area. The three thermomodules are individually fused on the DC Power pcb. A thermistor is used to detect temperature. The thermistor resistance increases as the Reagent Tray is cooling. When the resistance equates to 5°C the thermomodules

are turned off. When the thermistor resistance decreases the thermomodules are turned on to begin cooling again. This cycle continues to maintain cooling of the reagent tray.

If the Reagent Tray temperature exceeds approximately 15°C an alarm is displayed on the system PC. System operation is not interrupted or inhibited if reagent tray temperature alarms.

6.1.3 Check out / Adjustments

6.1.3.1 Measuring RGT compartment temperature

Temperature in the Reagent compartment can be measured by a thermometer.

6.1.3.1.a Measuring temperature by thermometer.

a. Place a beaker full of water inside the reagent compartment and close the Reagent compartment with the cover, wait several minutes in order to allow the temperature of the water to stabilize. View the thermometer several times to determine stabilization.

b. After the thermometer is stabilized record the value. Temperature should be between 5°-15° C or 41°-59° F.

6.1.3.1.b Adjustment of Reagent Tray Cooling

a. Locate the DC Power pcb. Connect a Digital Voltmeter between TP3 and TP2 (ground). If necessary, adjust VR-2 to obtain a voltage of 2.56 vdc ± 20 mv.

b. On the DC Power pcb disconnect the Reagent Tray thermistor CN-8. Connect a Digital Voltmeter between TP1 and TP2 (ground). If necessary, adjust VR-1 to obtain a voltage of 5.00vdc ± 50mv.

c. Reconnect the Reagent Tray thermistor CN-8.

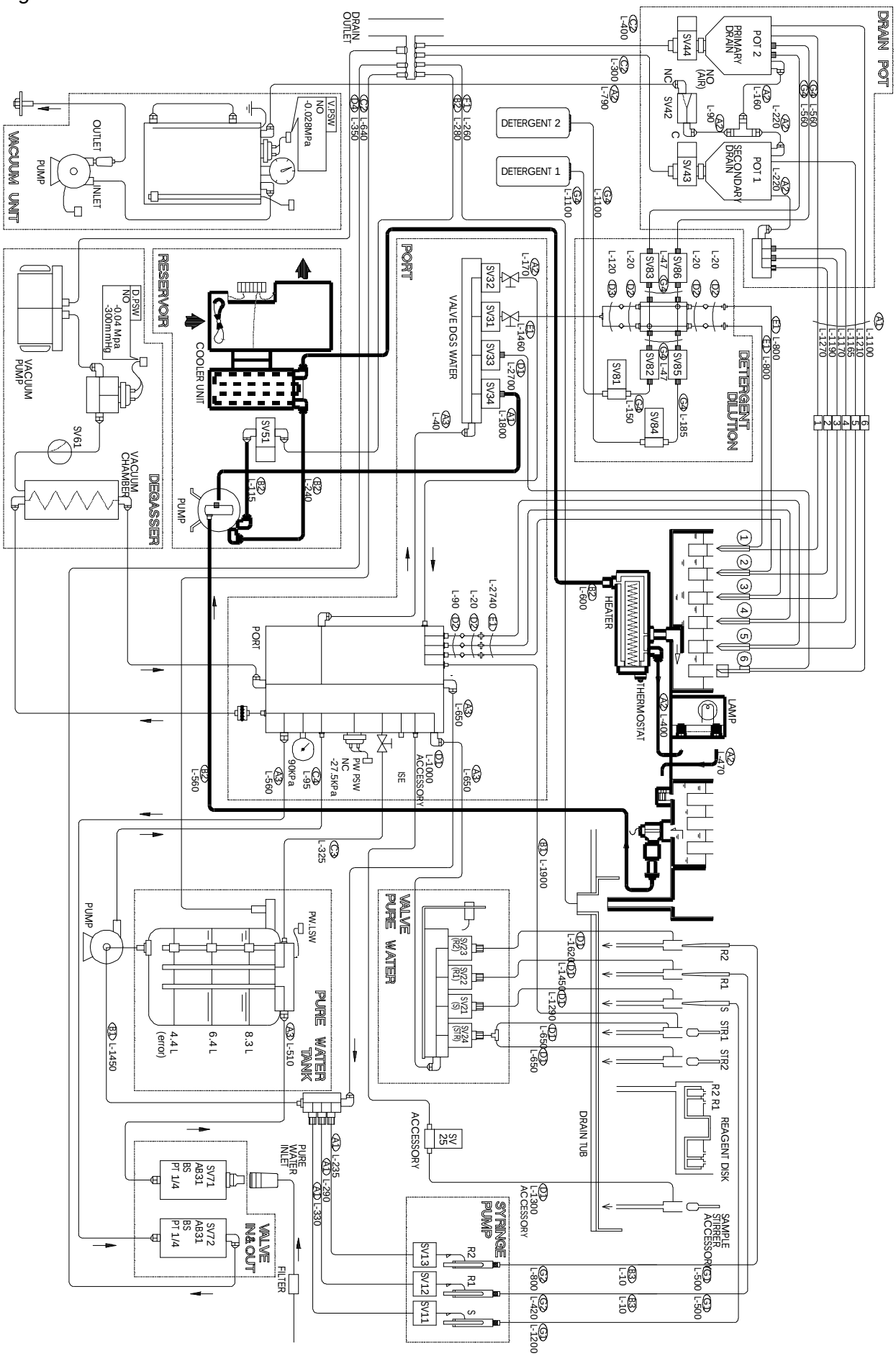
6.2 Incubator bath

The incubator assembly maintains the incubator water level and temperature at 37°C or 98.6°F . The incubator utilizes a water bath and degassed water, which is supplied and circulated by the circulator pump. The water level is sensed by a sensor probe assembly which controls SV34, this controls addition degassed water into the system if required. Temperature is maintained by the degassed water flowing through the cooler unit and then circulated , sensed and heated to a constant temperature (37°C) by the heater assembly. Heating control is accomplished and adjusted at the Assembly Temp Control PCB. See table 6.1 for descriptions. The Temp Control PCB also generates +5vdc, +15vdc and -15vdc which is used to power other circuitry. The bath water also cools the Lamp Housing. If Lamp Housing temperature reaches 65°C a thermostat located in the housing will open removing power from the lamp. If the thermostat opens it must be replaced. The thermostat requires an extremely cold temperature to reset.

Table 6.1.

Incubator connections	Description
Solenoid valve 34 (SV34)	Control the feed of water to the bath assembly.
Pump	Provides water bath circulation.
Cooler unit	Cools Bath and aids in thermal regulation.
Heater/Thermostat	Heats and regulates bath water temperature. Thermistor resistance is 8.521KOhm at 37°C
Incubator Bath	Provides circulation of bath water around cuvettes for incubation.
Lamp housing	Cools the lamp, cancels lamp housing from affecting incubation. Thermostat protects lamp housing if temperature reaches 65°C.
Solenoid valve 51 (SV51)	Drain degassed water and incubator to system drain.
Bath level sensor	Detects the level on bath water and controls SV34.
Temperature Control PCB	Controls bath temperature .This is accomplished with the use of the heater and thermistor assembly. Also generates +/- 15 vdc, +5 vdc for use by other circuitry.

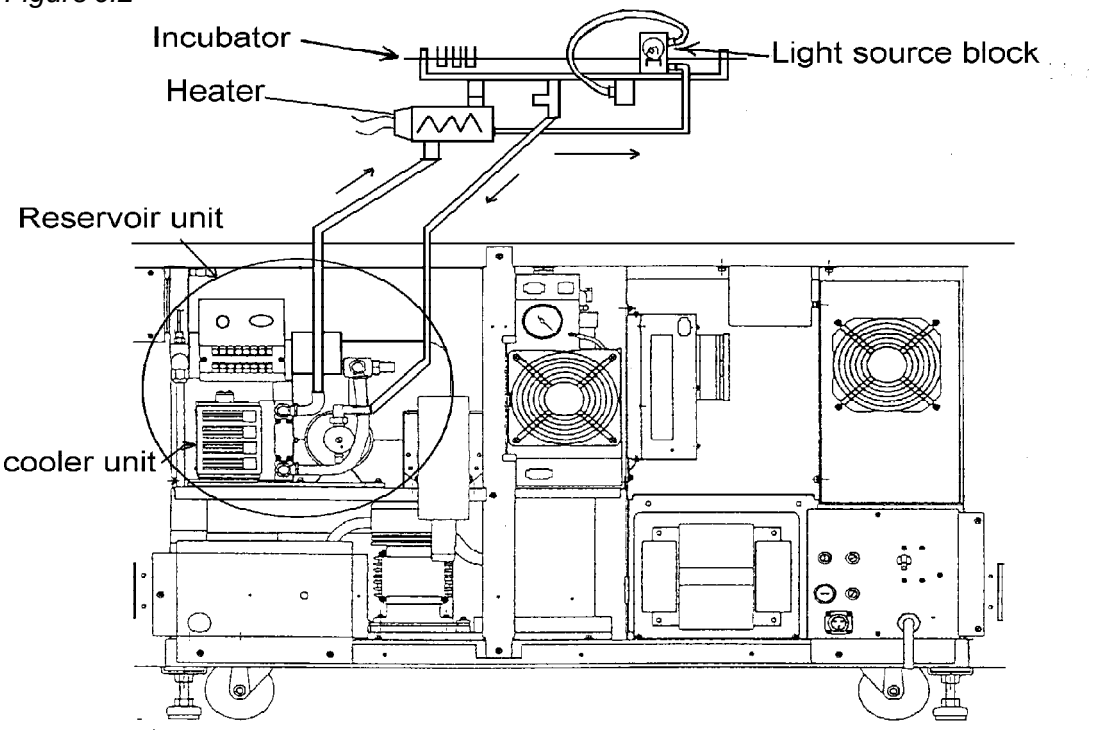
Figure 6.1 - incubator fluidics



6.2.1 Hardware description

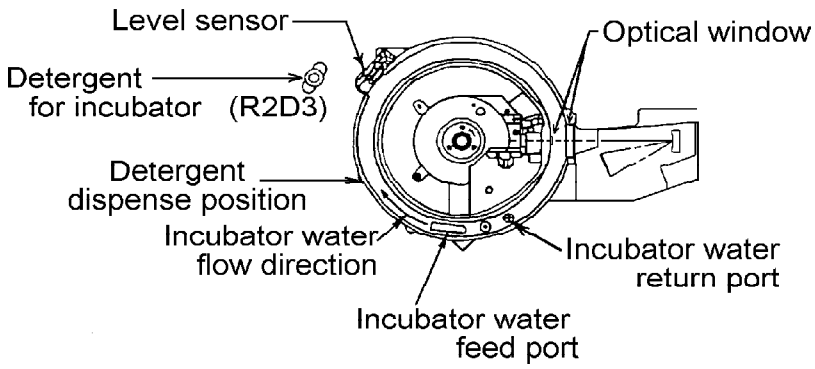
The incubator system ultlizes a pump, a cooler, a heater/ thermistor and a bath assembly.

Figure 6.2



The lamp housing is also part of the flow system and may have an influence on the bath system. The bath assembly provides liquid level sensing and the ability to fill and drain on command by direct interaction or scheduled commands from the System PC. The use of solenoid valve (SV34) adds water to the bath and solenoid valve (SV51) allows the incubator bath assembly to drain.

Figure 6.3



6.2.2 Operating cycle

When the analyzer in turned on, the pump circulates the bath water around the incubator system. Bath water is pumped into the cooling unit, this decreases the bath temperature so it can be heated and measured at the Heater/ thermistor assembly to a constant temperature. The bath water enters the bath assembly and the water level is sensed by the bath level sensors, additional degassed water through solenoid valve (SV 34) can be received when the level is detected low by the sensors.

If a low level is detected for a period of time, the analyzer will request the R2 probe to dispense detergent automatically into the bath. No warning is given to the probe movement . Injury may occur.

The bath water also circulates around the lamp housing and is returned to the bath assembly. This is drawn out of the bath through a out flow port and is recirculated through the incubator system by its circulator pump.

The cooler assembly reduces the bath temperature by circulating the water through cooling fins to draw the heat out of the water. A fan forces air passed the fins to provide the cooling operation.

The heater provides a regulated source of heating and a thermistor to sense the temperature of the incubator. The Temperature control PCB controls the temperature of the bath water.

The bath assembly is a plastic housing that provides water circulation for the incubation of the cuvettes. It has flow connectors that provide inlet and out flows for the circulated bath water. The bath level sensor is located on the assembly and is seated next to the overflow port.

The lamp housing is included in the flow of the incubator. It is separate and only provides cooling for the quartz lamp .

6.2.3 Check out and adjustments

Tools and test equipment.

Incubator bath temperature adjustment will require the temperature test box, or digital thermometer.

6.2.3.1 Adjustment procedure bath temp.

6.2.3.1.a Using Temperature Test Box (Preferred Method)

1 . Calibrate the test box. The test box output for the 37°C mode must be adjusted to 8.521KW. Set switch B to 37°C position and connect an ohmmeter to the cable connector pins 9 and 7. Adjust pot to 8.521KW.

2. Connect the test box to CN12 on the Temp Control PCB. Turn on power. (see figure 6.4 Temp Control pcb)
3. Make sure that LED19 (bath water level sensor status) is extinguished while the switch “A” on the test box is closed, and that LED19 is lit while switch “A” is open. Close switch “A”.
4. Connect the digital voltmeter between TP3 (ground) and TP8. If necessary adjust VR1 to 5.0vdc ±10mV. Paint lock VR1.
5. Set the switch to “37°C”. Connect the digital voltmeter between TP3 (ground) and TP10. If necessary adjust VR3 to -3.7vdc ±10 mV. Paint lock VR3.
6. Connect the digital voltmeter between TP3 (ground) and TP9. If necessary adjust VR2 (heater control) to +3.7vdc ±10mV.
7. Connect the digital voltmeter between TP3 (ground) and TP11. If necessary adjust VR4 (display reading) to 0vdc ±20mV.
8. Disconnect the test box and reconnect CN12 on the Temp Control bd.

6.2.3.1.b Using Thermometer (Alternative Method)

1. Insure the bath level is full and has been warmed up for at least 15 minutes. Also insure cuvettes are filled with DH20 (approx 400ml) and warmed up for at least 15 minutes.
2. Place the thermometer probe into cuvette 55 on the reaction disk. Allow sufficient time for the thermometer to stabilize.
3. Connect the digital voltmeter between TP3 (ground) and TP8. If necessary adjust VR1 to 5.0vdc ±10mv.
4. Observe the temperature indicated on the thermometer. If it is not 37°C +/- 0.1 the temperature must be adjusted. Adjust VR2 until the thermometer indicates 37°C ± 0.1. Adjust VR2 slowly. There will be a lag between the adjustment and the temperature change due to the circulation of the water and efficiency of the heater. VR2 is a 30 rotation pot. One complete rotation is equal to approximately 0.047°C. Clockwise rotation will decrease temperature.
5. After the temperature has stabilized at 37°C connect the digital voltmeter between TP3 (ground) and TP10. Voltage should be approximately -3.7vdc
6. Connect the digital voltmeter between TP3 (ground) and TP9. Voltage should be approximately +3.7vdc.
7. The temperature indication on the CRT display should match the temperature indicated on the thermometer. If necessary adjust VR4 until the display matches the thermometer temperature. Connect the digital voltmeter between TP3 (ground) and TP11. Voltage should be approximately 0.0vdc.

After completion of temperature adjustment observe LED's 22 - 29 on the Temp Control PCB. When the incubator bath is at 37°C LED 22 (MSB) should be lit.

X means LED "ON"———O means LED "OFF"

led22———led29	
XOOOOOOO	**36.9°C**
OXXXXXXX	**37.0°C**
OXXXXXXO	**37.1°C**

Figure 6.4

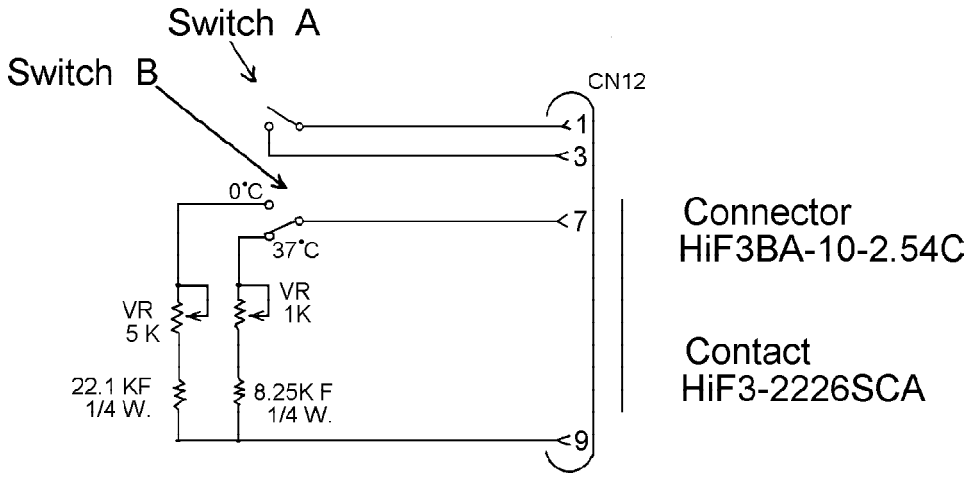
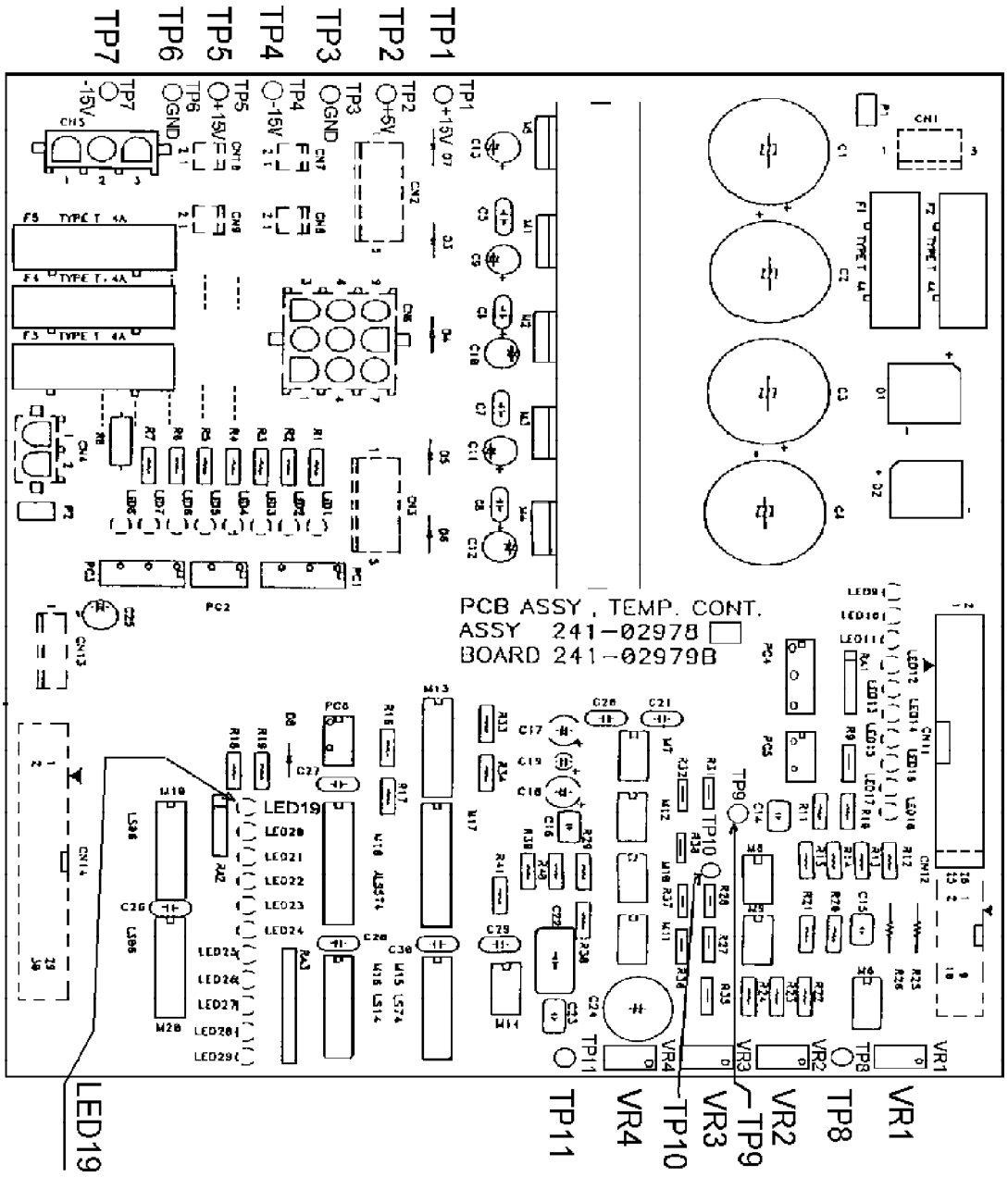


Figure 6.5

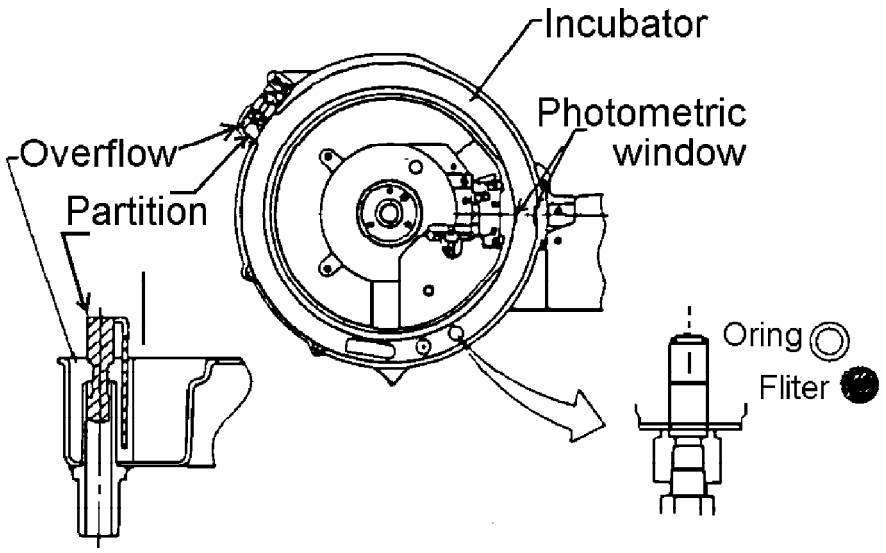


6.2.3.3 Checkout of water level sensor

There is a liquid level sensor which controls the incubator water level on the left side in the incubator. This level sensor ,which is electrode type can not detect the incubator water if it is stained. Cleaning of the level sensors should be done once a month with a soft cloth, the analyzer should be turned off to avoid injury.

There is no adjustment for the incubator water level sensor.

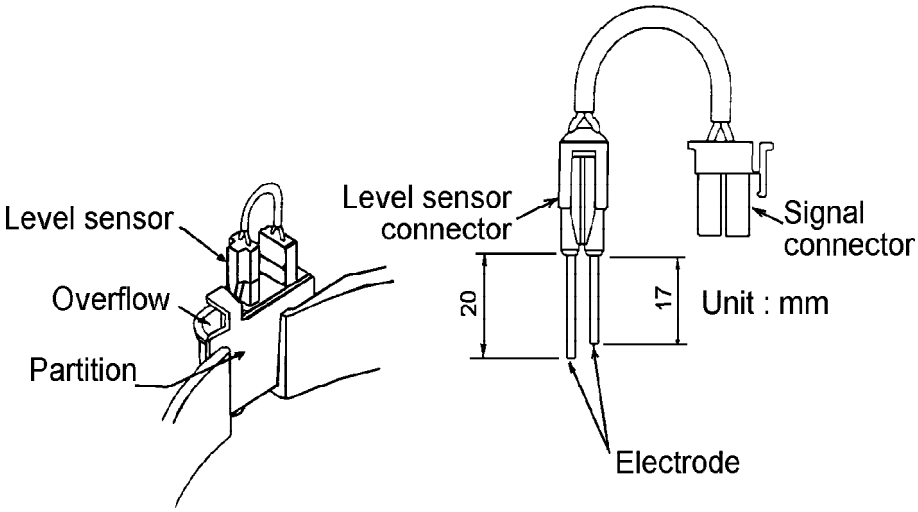
Figure 6.6



When the power to the equipment is turned on, do not remove the liquid level sensor. If this is removed ,the analyzer interprets the removal as insufficient incubator water levels and is replenished automatically.

A caution should be noted, if this conditions continues for a period of time the 2nd reagent probe will move automatically to dispense detergent into the bath. This is to maintain the detergent concentration of the incubator water. Injury may occur.

Figure 6.7



Clean the water level sensor as follows:

1. Turn off power
2. Hold the hook connector of the liquid level sensor and pull out the two connectors together.
3. The electrodes of the liquid level sensor are located on the smaller connector. Check them for stains.

   If there are stains on the electrodes, wipe them off with a soft cloth or tissue carefully. Take care not to break them and if the ends are corroded or shows signs of wear replace them.
4. Re-place the liquid level sensors.
5. Turn on the power.

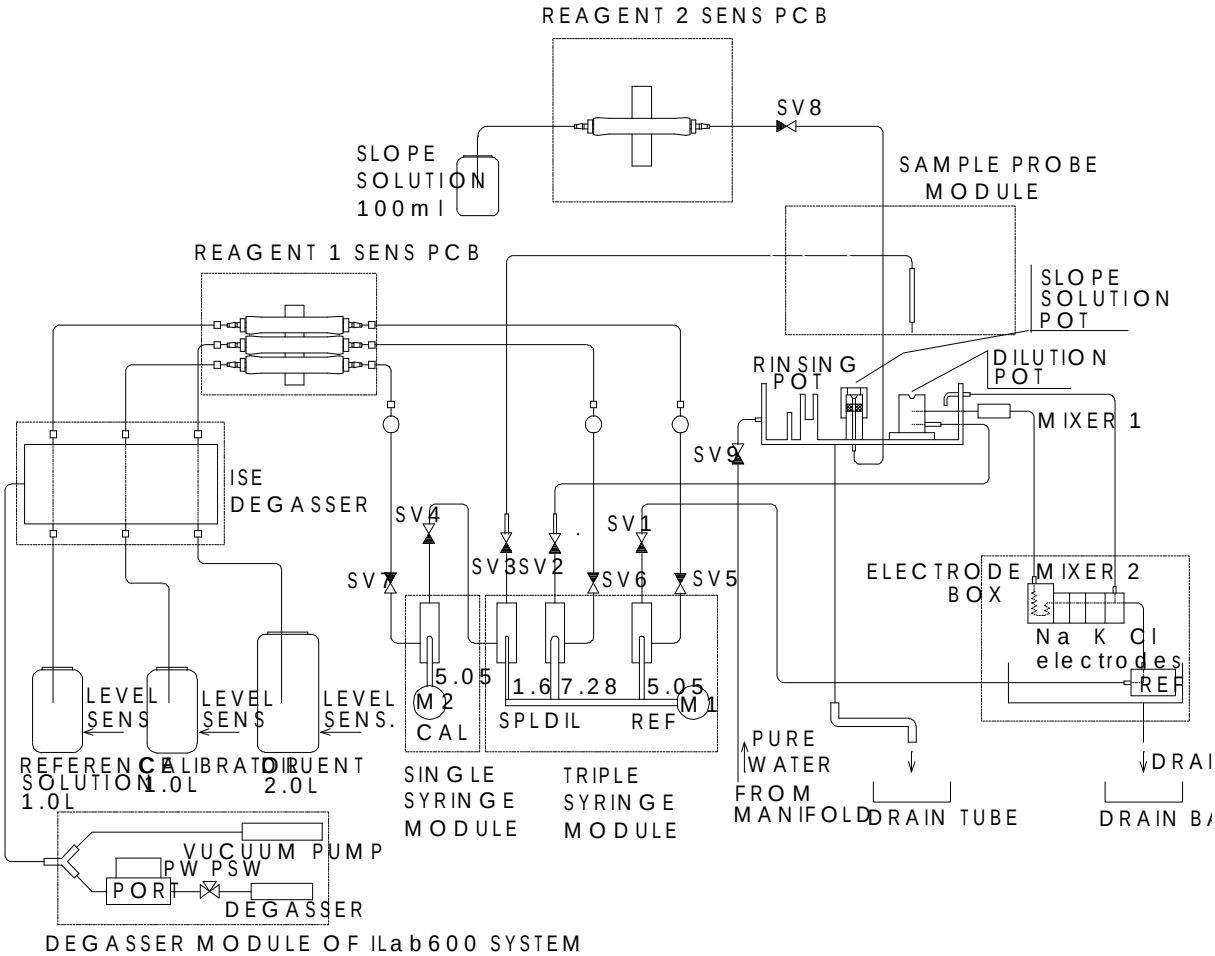
7 ISE

7.1 ISE Description

ISE module is an option of the ILab600 system, and it is used for the determination of Na, K and Cl in sample solution.

A diagram indicating the fluidical and mechanical items (including the fluidics sensors) is shown in figure 7.1.

Figure 7.1 - ISE block diagram



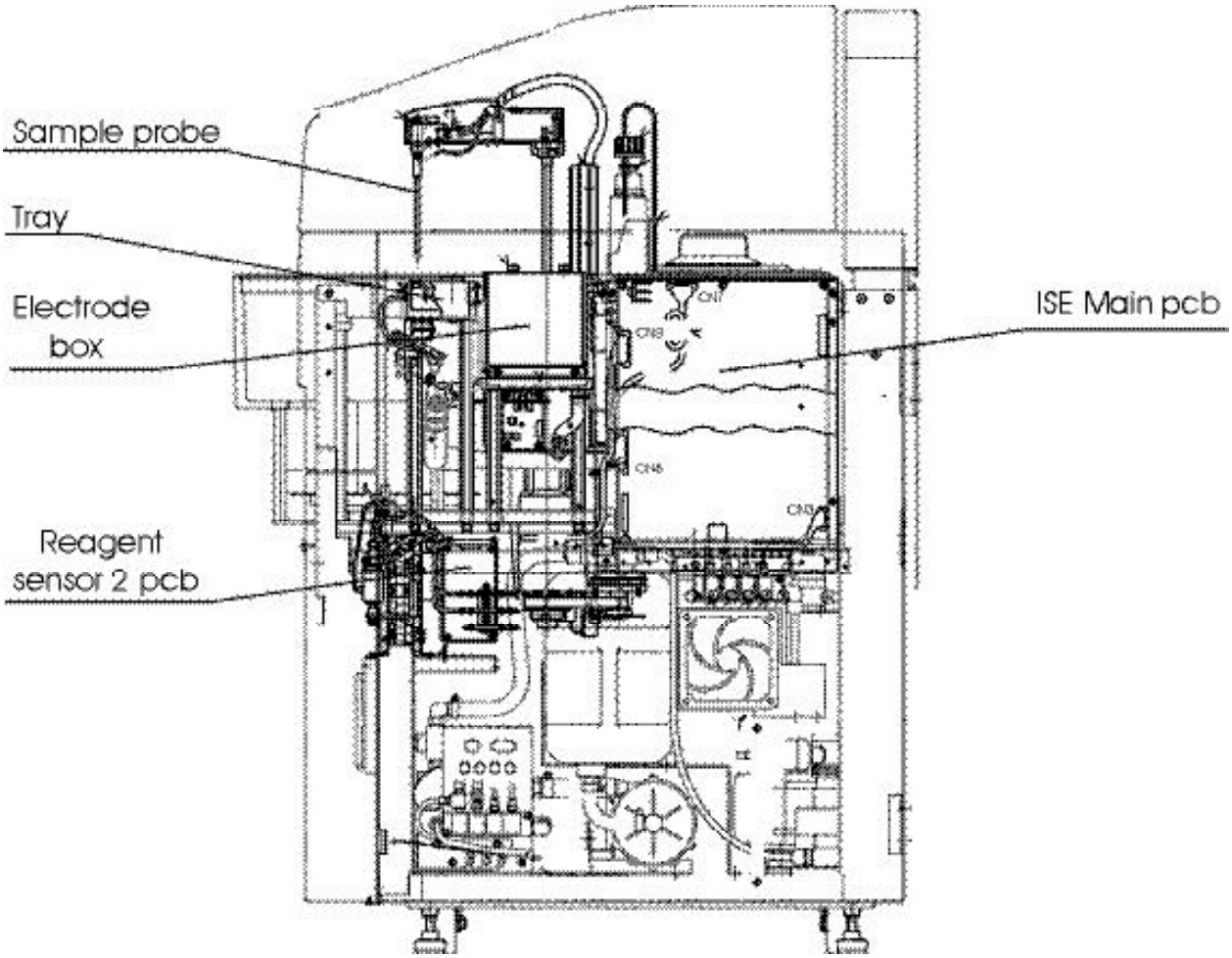
Main items are the following:

a. three Ion Selective Electrodes plus the Reference electrode for the determination on Na, K and Cl concentration of a sample solution. Electrode are housed into the Electrode box.

b. ISE on-line solutions are the following:

Solution	Concentration (unit:mmol/l)
Calibrator (1.0 l)	Na:140 K:4.0 Cl:100
Slope solution (0.1 l)	Na:200 K:8.0 Cl:160
Diluent solution (2.0 l)	Na:7.0 K:0.2 Cl:5.0
Reference solution (1.0 l)	1M ammonium chloride

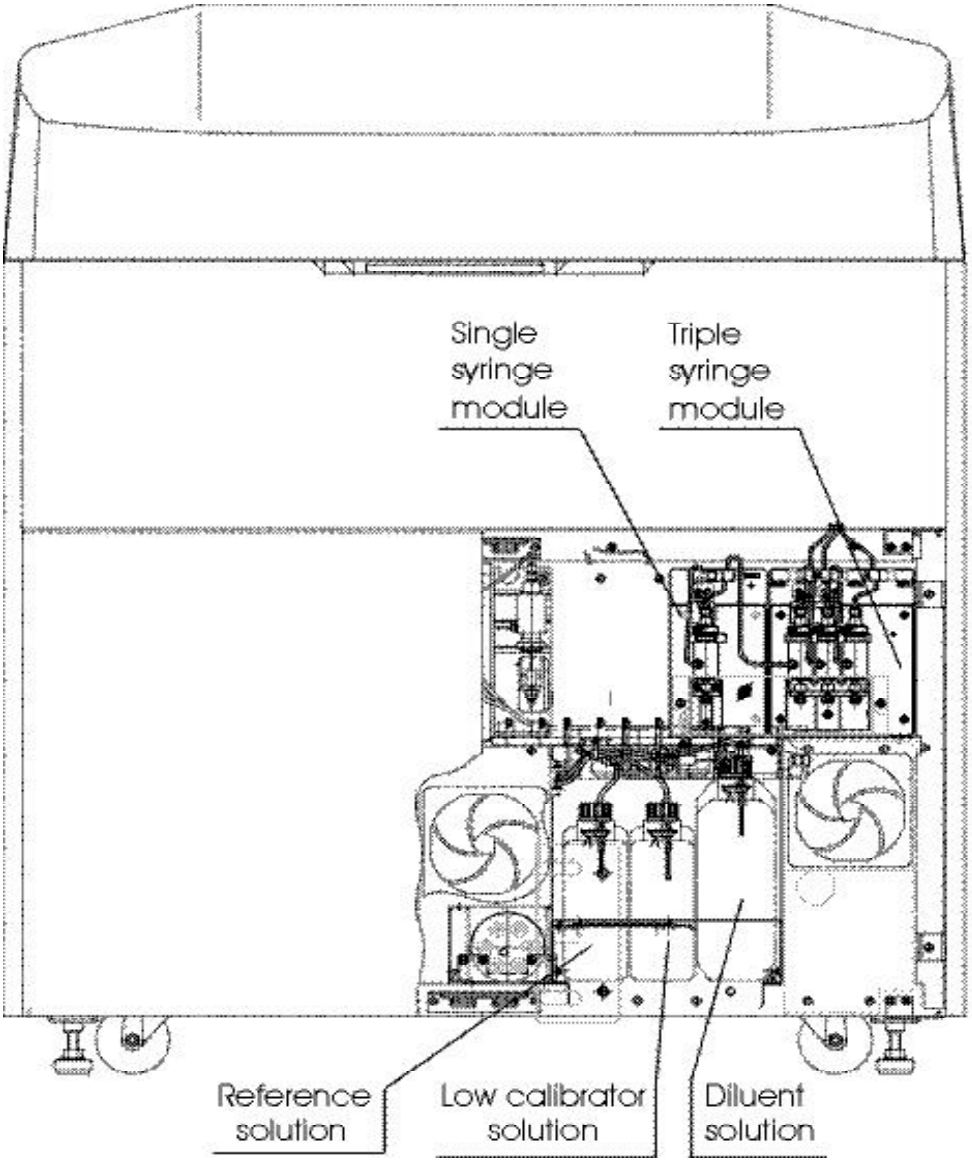
Figure 7.2 - location of ISE main items, side view



c. Reagent 1 sensor pcb and Reagent 2 sensor pcb are equipped by optical photosensors for monitoring the presence of liquid/air bubbles in the supply piping of reference solution,

calibrator, diluent and slope solution.

Figure 7.3 - Location of ISE main items, front view



d. ISE degasser is used for degassing degassing diluent, calibrator and reference solution.

e. Triple syringe module is used for aspirating and dispensing sample, diluent and reference solutions. Operation is performed by a stepper motor that controls the three specific syringes which handle the three solutions. The three syringe pistons are moved together by a single plate.

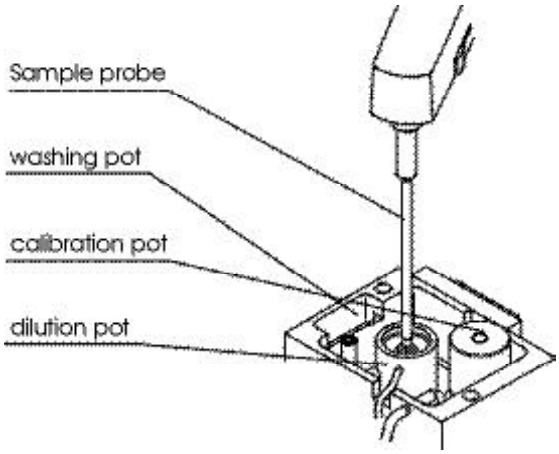
f. Single syringe module is used for aspirating and dispensing calibrator solution.

g. Sample probe module is used for aspirating the required

volume sample/slope solution from the sample cup/tube and slope pot and for dispensing into the dilution pot.

h Tray including the Dilution pot, Slope solution pot and Rinsing pot (see fig 7.4).

Figure 7.4 - Tray



7.1.1 Principle of operation

Analytical cycle is performed as follows:

a. Sample/slope solution is aspirated from sample cup/slope pot (sample volume is 24 ul) through the sample probe by the sample syringe. At the same time also the diluent and reference syringes are filled by diluent and reference solutions.

   As the required sample volume has been picked-up, sample syringe continues aspirating calibrator solution.

b. Sample is dispensed into the dilution pot. At the same time also diluent and reference solutions are dispensed.

   Diluent is dispensed into the lower inlet of the dilution pot: sample+diluent are mixed (in mixers 1 and 2) then injected into the electrode box,where the electrical offset of sample measurement is detected.

   Reference solution is injected into the reference electrode. Purpose of the reference solution is to provide electrical interconnection between Na, K and Cl electrodes (through the sample path).

c. As all sample has been dispensed, the triple syringe module continues dispensing calibrator solution plus diluent and reference solution. Reading of the electrical offset of calibrator measurement is recorded.

d. At the completion of the measurement cycle the sample probe

is moved into the rinsing pot and it es washed inside and outside.

e. Analysis cycle is completed. The ISE module is ready for a new cycle.

f. Internal calibration cycle is performed similarly as per above steps a. to d. but, instead of sample solution, Slope solution is measured.

7.1.2 ISE Specification

Sample type:	*Serum, Plasma, urine*	
Measuring range:	*Na:*	*10 to 400 mmol/l*
	K:	*1 to 200 mmol/l*
	Cl:	*15 to 400 mmol/l*
Measuring method:	*Indirect potentiometry*	
Sample volume:	*24 µl*	
Dilution ratio:	*1:21.7*	
Throughput:	*1 sample/27 sec*	
Calibration:	*1:*	*Automatic two point calibration (by on-line cal. and slope sol.)*
	2:	*3 point calibration, periodical (by external calibrators)*
Electrodes:	*Na:*	*Crown ether liquid membrane type PVC electrode*
	K:	*Valinomycin liquid membrane type PVC electrode*
	Cl:	*Quaternary ammonium salt type solid membrane electrode*
Reagent:	*Diluent:*	*1435 µl/sample*
	Calibrator:	*390 µl/sample*
	Reference solution:	*690 µl/sample*
Temperature:	*15 to 30 °C (fluctuation less than +/-3°C/hour)*	
Humidity:	*45 to 80% RH (defrost)*	
Power supply:	*supply through the ILab600 system (consumption approx 60VA)*	

7.2 ISE Electronics description

A block diagram of ISE electronics is reported in figure 7.5 in next page.

Main boards of the ISE electroncs are:

- ISE Main pcb
- ISE preamp pcb
- Reagent sensor 1 pcb
- Reagent sensor 2 pcb
- ISE nozzle pcb

A detailed description of each pcb is provided here below:

7.2.1 ISE Main pcb

(Refer to the electronic diagram included in the manual "ILab600 - Field Service Drawings).

The ISE main board performs the following tasks:

a. controls and drives all the mechanical modules (ISE sample probe module, single syringe module, triple syringe module.
b. drives all the ISE solenoid valves (9 electrovalves)
c. receives the electrodes offset reference from the ISE preamp. pcb and performs A/D conversion
d. monitors status of the reagent sensors (4 sensors) and the bottle sensors (3 sensors)

The ISE main board communicates with the ILab600 system by a serial line (current loop)

Main items of the ISE main board are:

CPU microprocessor

IC M16 (80C85A) is the CPU, and controls the operations of the ILab600 ISE module. The operation speed of the CPU is 4 MHz because the CPU divides the oscillator Xl into 1/2.

IC M25 (27512) is a ROM in which the programs specifying the CPU operations are saved.

IC M26 (84256) is a random access memory (RAM). The maximum physical memory capacity of the ROM and the RAM is 56 kB and 32 kB respectively.

The maximum address space of the CPU is 64 kB, the CPU can access only 56 kB of the ROM and only 8 kB of the RAM.

IC M17 (TL7705) is an IC to reset the CPU. M17 sends the reset signal (L level) to the CPU when the 5 VDC power supply is 4.5 V or less to prevent overrun of the CPU during turning on of the power or random power interruption.

IC M18 (HC245) is a buffer for the address of the CPU signal output.

IC Ml9 (HC373) holds the address output from the CPU on the time-sharing basis and holds the address signal contained in the data.

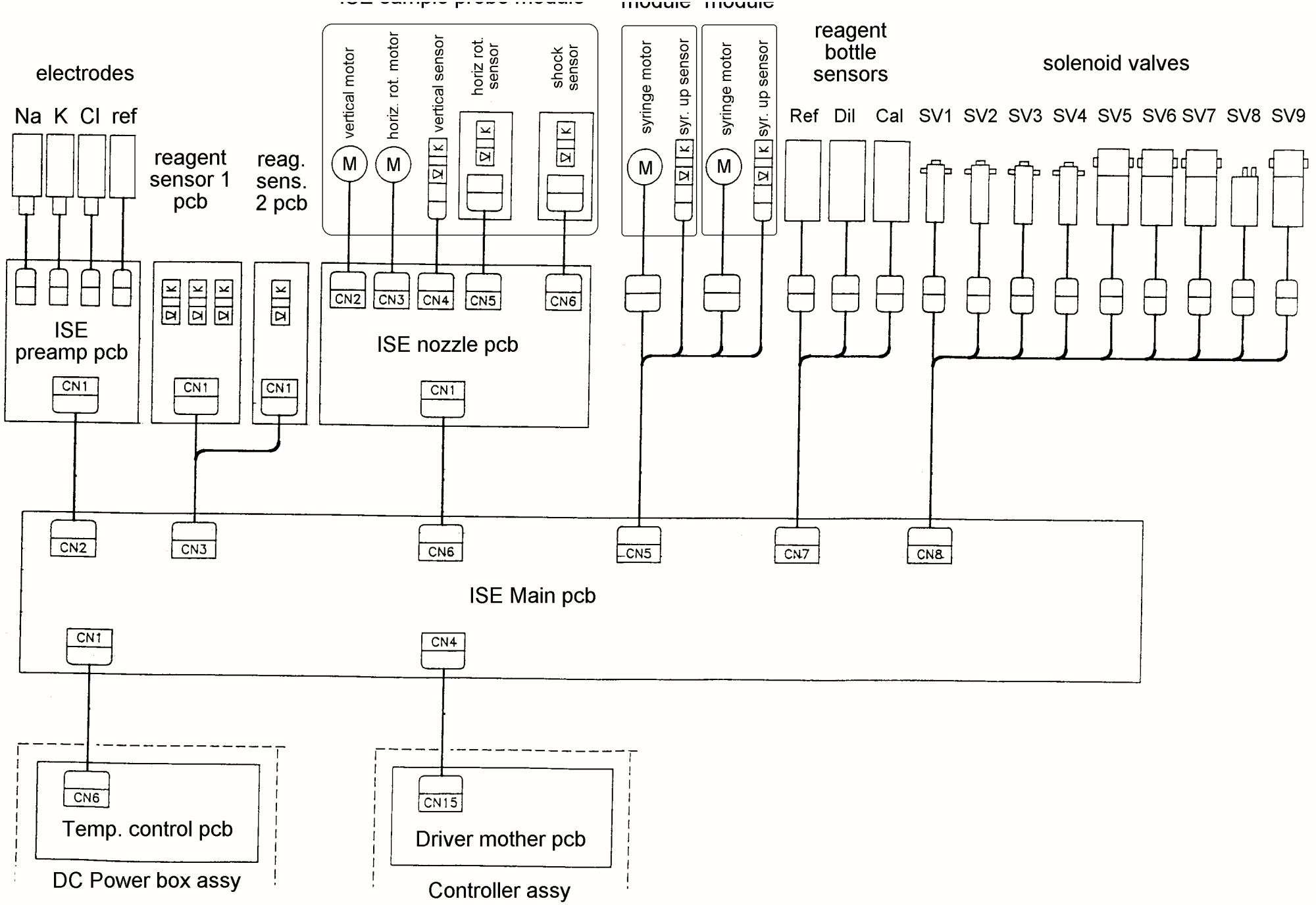
ICs M24, M27 M28 and M29 (HC138) are decoders. They decode the address signal from the CPU, and output the selective signal to the ROM/RAM and the I/O control IC.

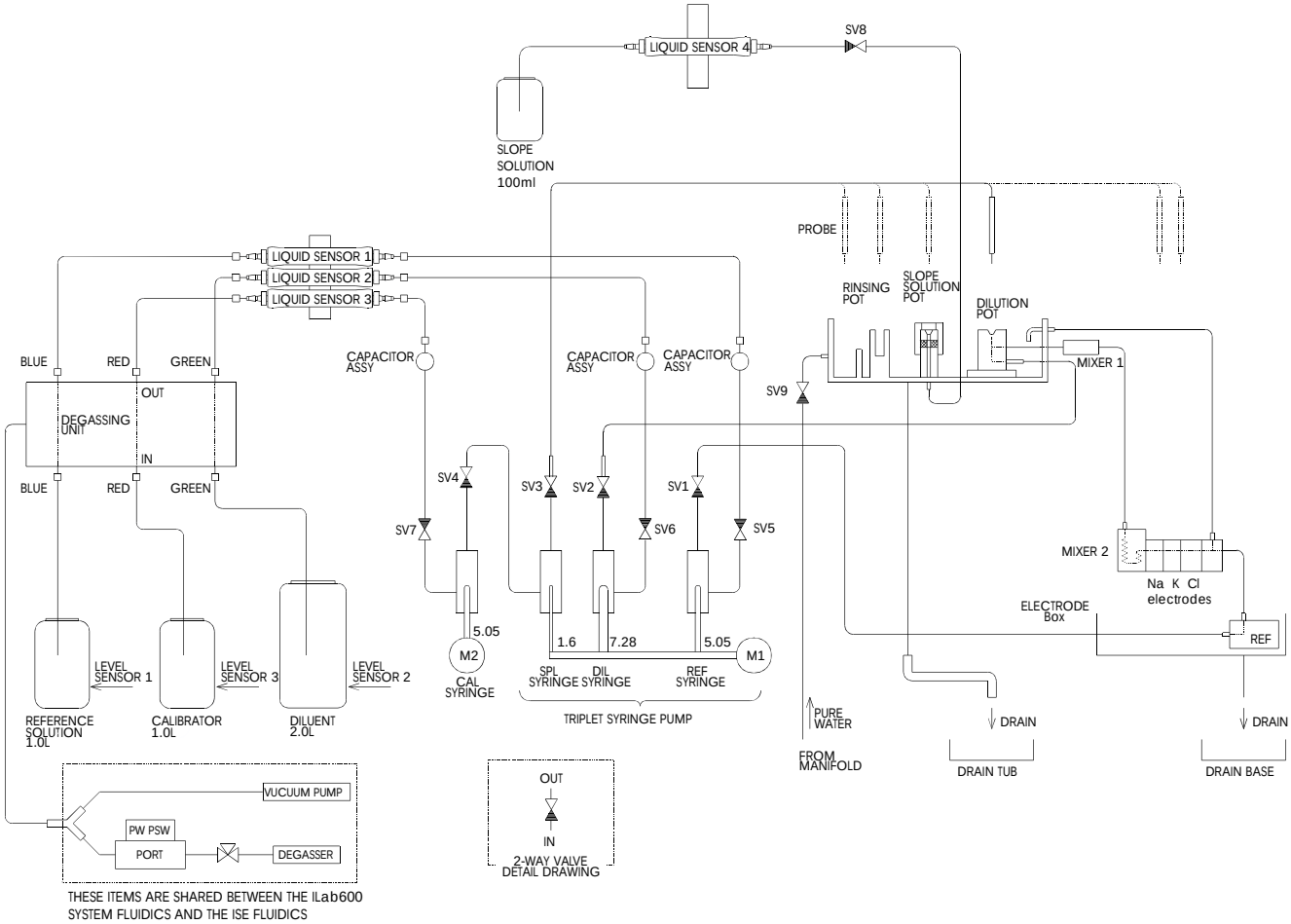
IC M30 (HC245) is a data bus buffer between the CPU and the I/O control IC.

IC M31 (82C59) is controls CPU interruptions.

ICs M32 and M33 (82C53) are timer ICs. They count the clock signal, and send the count completion signal to the M31 when the value specified preliminarily by the CPU is reached.

IC M31, when receiving the count completion signal, starts interruptions of the CPU (time control and driving of the pulse motor by the CPU).


electrodes
Na K Cl ref
reagent sensor 1 pcb
reag. sens. 2 pcb
vertical motor
horiz. rot. motor
vertical sensor
horiz rot. sensor
shock sensor
syringe motor
syr. up sensor
syringe motor
syr. up sensor
reagent bottle sensors
Ref Dil Cal
solenoid valves
SV1 SV2 SV3 SV4 SV5 SV6 SV7 SV8 SV9
ISE preamp pcb
CN1
ISE nozzle pcb
CN1 CN2 CN3 CN4 CN5 CN6
ISE Main pcb
CN1 CN2 CN3 CN4 CN5 CN6 CN7 CN8
Temp. control pcb
CN6
DC Power box assy
Driver mother pcb
CN15
Controller assy



THESE ITEMS ARE SHARED BETWEEN THE ILab600 SYSTEM FLUIDICS AND THE ISE FLUIDICS

Communication with ILab600

IC M37 (82C51) performs serial communication between the ISE CPU andILab600 main unit. Serial communication is performed in the current loop, and the +12 V power supply for serial communication is provided by IC M59 (7812).

IC M38 (8640C) generates the clock for serial communication. The clock frequency can be set by DIP switch S1, which determines the serial communication speed.

Serial communication is performed via the CN4. Pins 5 to 18 of CN4 are used for transferringe information on system status (READY, sampling being performed, sampling enabled, error, etc.).

IC M39 (HC175) is a latch for the output from the CPU, and changes the status information signal in accordance with the signal sent from the CPU.

ICs M40 and M41 (HC245) are tri-state buffers for the input to the CPU, and helps the CPU while the CPU is reading the status information signal and the status of the DIP switches Sl and S2. (functions of the DIP switches are described later).

Electrometry

CN2 is connected to the preamplifier. Pins 3, 7, 11 and 13 are the output the Na , K , Cl and reference electrodes respectively. Electrode offset during analysis may be monitored by connecting a recorder between TP 4 (negative) and TP 1 (Na), TP 2 (K) or TP 3 (Cl). Pins 1, 5 and 9 are the output from the Na, the K and the Cl subtracted by the output from the reference electrode and amplified by 20 times. They are handled through the low-pass filter consisting of the resistor and the capacitor as well as the buffer amplifiers Ml and M2, then are connected to the input of the analog multiplexer M5 (ADG526A).

Liquid sensors

The output of the liquid sensors are also connected to the analog multiplexer M5 (ADG526A) through connector CN3.

A/D conversion

The analog multiplexer selects and outputs one input at the time, so performing the same function as a rotary switch.

A/D conversion is performed by the V/F converter M6 (AD652) which converts voltage reference into frequency, the timer IC M8 (82C53) and the counter ICs M10 to M12 (HC393) which count the frequency over the period specified by the CPU. CPU then reads the count value.

Specification of A/D conversion are the following:

M6 input: -5 to +5 VDC

M6 output: with input -5VDC: 0Hz

M6 output: with input +5VDC: 1MHz

Wave form of M6 output: square wave 0-5VDC

The count-period (A/D conversion period) is shown below.

(Na-REF) x 20: 200 ms

(K-REF) x 20: 200 ms

(Cl-REF) x 20: 200 ms

REF: 100 ms

Liquid sensor: 100 ms

Analog ground: 100 ms

Resolution of A/D conversion is: 10 V/(l MHz x 0.2) = 50μV when the conversion period is 200 ms. As Na/K/Cl electrode output is amplified by 20 times by the amplifier, the resolution of Na, Cl and K is 2.5μV, 2.5μV and 5.0μV respectively.

Bottle sensors

Level of the diluent, calibrator and reference solution bottles is monitored by electrostatic capacity liquid sensors. The electrostatic capacity liquid sensors output is an ON/OFF signal, and they are connected to connector CN7. When the remaining quantity of the reagent inside the bottle becomes approximately 1/10 or less, the electrostatic capacity type bottle liquid sensor switches to OFF and the system detects bottle shortage. When the remaining quantity of the reagent is 1/10 or more, the output is ON (L).

Motor drivers

ICs M51 (HC175) and M52 (LS06), M43 to M46 (HC175), and the M47 to the M50 (SLA7024M) are the pulse motor driving circuits.

Description of the syringe pump drive motor is provided below:

-The CPU generates the pulse motor driving signal.

-IC M43 (HC175) receives the syringe pump pulse motor driving signal sent from the CPU and controls to the pulse motor driver IC M47 (SLA7024M).

-M47 drives the pulse motor at a constant current.

-the constant corrent value is set by R23, R19, R39 and R40.

-two values of constant current are set automatically: high current, used during high speed cycle, and low current, used during low speed cycle.

-current values are the following:

Motor	High current	Low current
Syringe pump1	- - -	400 mA
Syringe pump2	- - -	400 mA
Probe vertical	800 mA	400 mA
Probe rotation	- - -	400 mA

-Motors of pump1 and pump2: run always at low current. When motor is not running (in stop position), it is not energized (it is released)

-Motor of probe vertical runs as follows:

hig-speed operation (>1,500 PPS):	high current
low-speed operation (<1,500 PPS):	low current
stop position:	low current

-Motor of probe horizontal runs always at low low current

The CN5 is connected to the pulse motor for the syringe pump 1, the pulse motor for the syringe pump2, the photo sensor for detecting the home position of the syringe pump1 and the photo sensor for detecting the home position of the syringe pump2.

Typical resistance of the stepper motor windings is 3 to 5 Ohm

Solenoid valves

ICs M53, M54 (HC273), and M55 to M58 (TD62064) are the solenoid valve driver circuits.

M53 and M54 receive the valve driving signal output from the CPU, and control M55 to M58 which are the solenoid valve power drivers (transistor arrays). 24 VDC is always applied to one end of the solenoid valve, and the other end is connected to the transistor array. Transistor array works as a switch, connecting the solenoid valve to the power ground.

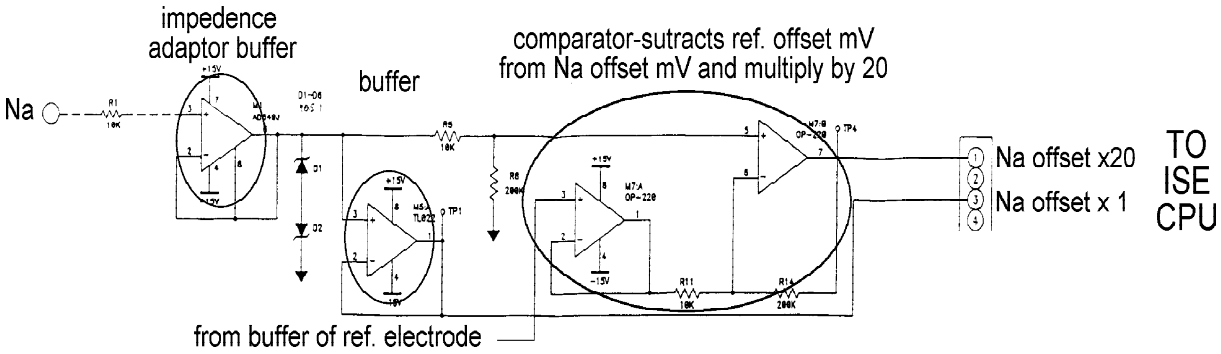
7.2.2 Preamplifier description

Data acquisition is performed by Ion Selective Electrodes. Electrodes offsets are connected to the Preamplifier pcb.

Figure 7.7 below shows a block diagram of one electrode preamplification channel. Preamplifier pcb includes 3 identical preamplifier channels for Na, K and Cl electrodes.

No amplification if provided for Reference electrode. Ref. electrode channel is buffered only.

Figure 7.7 - Preamplifier pcb block diagram



Principle of operation of the Preamplifier pcb is the following:

a. Electrode input is connected to an op amp that provides impedence adapting (high impedence input - low impedence output)

b. Output at gain 1 of Electrode offset is provided throug a buffer

c. Electrode offset is also subctracted of the Ref electrode offset, then it is amplified (amplifier gain 20).

d. Output at gain 20 is provided

c. The two electrode outputs are connected to the ISE Main CPU

7.2.3 Liquid sensors control description

Specific photosensors are used for monitoring the presence of air/liquid inside the ISE solutions supply tubings.

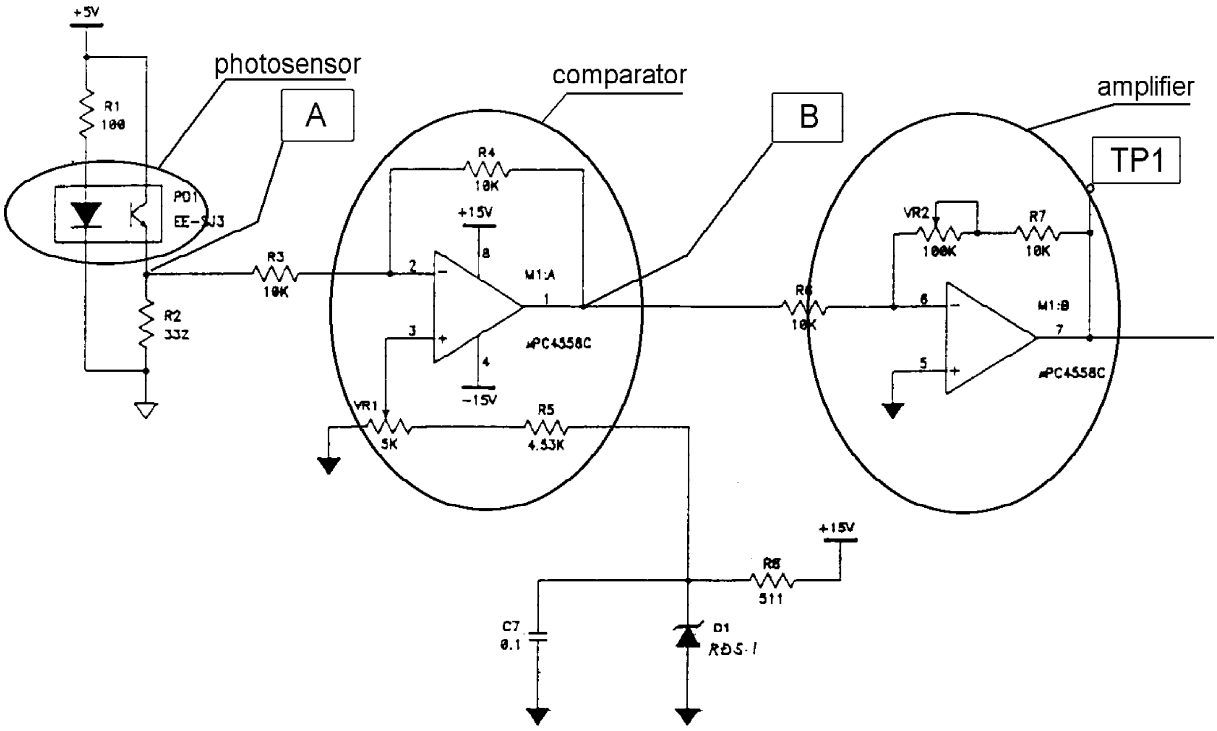
All photosensors are located in two PCBs monitoring the following solutions:

Solution	PCB
Slope solution	Liquid sensor 2 pcb
Diluent solution	Liquid sensor 1 pcb
Reference solution	Liquid sensor 1 pcb
Calibrator solution	Liquid sensor 1 pcb

Principle of operation:

a. figure 7.8 shows typical block diagram of liquid sensor circuitry. Main items are: photosensor, comparator and amplifier

Figure 7.8 - liquid sensor block diagram



a. Photosensor includes an emitter LED and a detector phototransistor. Tubing is located between emitter and detector. Whenever liquid is in the tubing, the light emitted by the LED reaches the phototransistor. Whenever air is in the tubing, light beam is scattered, and no light reaches the phototransistor.

Typical voltage measured on the phototransistor (position A) is:

Air: 2.5 to 4.0 VDC

Liquid: 0.2 to 1.0 VDC higher then air voltage

c. Purpose of the comparator block is to set a 0 VDC output value (position B) when air is measured. 0 VDC value is adjusted by trimmer VR1.

d. Purpose of the amplifier is to set an output difference of 3 VDC (TP1) between air and liquid measurement. Amplifier gain can be adjusted betwen 1 to 11 by trimmer VR2.

7.3 ISE Fluidics

Diagram of the ISE fluidics is shown in fig 7.6 page 7.7.

Detailed information on ISE fluidics operating cycles are provided in the timing diagrams in sec 7.5 ISE operating cycles description

7.4 Mechanical description

Mechanical modules of the ISE unit are described below:

Detailed information on mechanical operating cycles are provided in diagram in figure 7.12

7.4.1 Sample probe module

Purpose of the sample probe module is to pick-up the specified sample/slope solution volume from the sample tray/slope solution pot (24µl) and dispense it into the dilution pot.

Sample probe module is equipped by two stepper motors, for the vertical and rotational displacement of the probe.

Layout of the Sample probe module is shown in fig 7.9 below.

The sample probe (not shown in figure 7.9) is fixed to the sample probe holder. The holder is fixed to the probe arm by a spring shock absorber with a shock sensor. If a shock is detected during a vertical probe-down mechanical operation, the operation is interrupted immediately and an alarm is reported.

The sample probe is not provided by liquid level sensor. The system, in order to determine the sample level into the cup/tube, refers to the sample detection performed by the Chemistry sample probe module.

The sample probe module is provided by an optical sensor with mechanical flag for the vertical up/down operation. Integrity check of the vertical operation is performed at any cycle.

If any error is detected, the system stops and an alarm is reported.

The sample probe module is provided by an encoder disk for the horizontal rotational operation (refer to fig. 7.10 below). Integrity check of the rotational operation is performed at any cycle.

If any error is detected, the system stops and an alarm is reported.

Figure 7.9 - Sample probe module

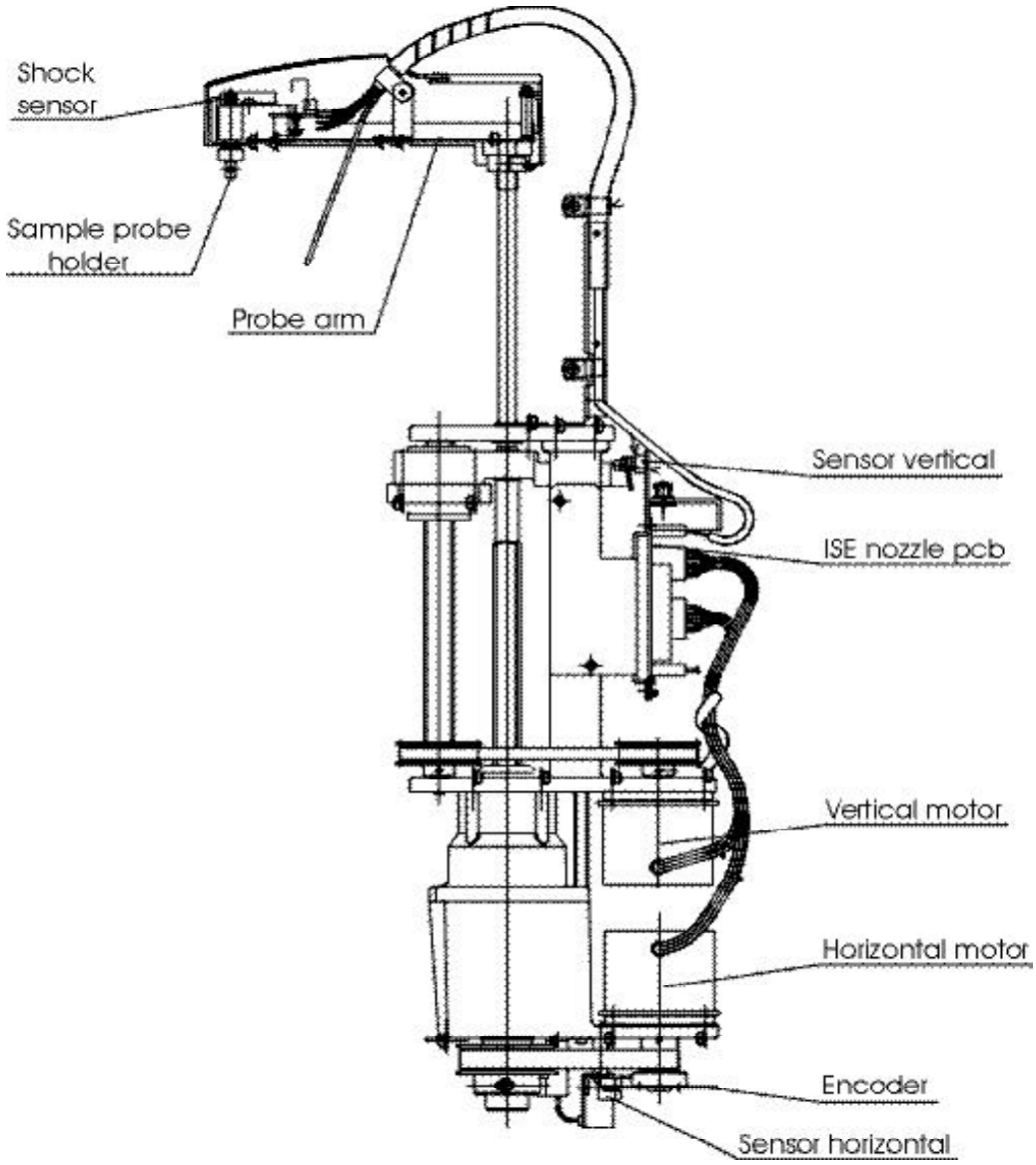
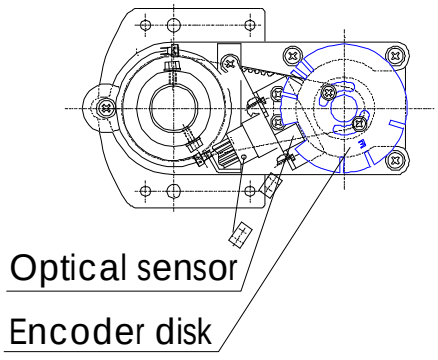


Fig. 7.10 - sample probe module bottom view



7.4.2 Syringe modules

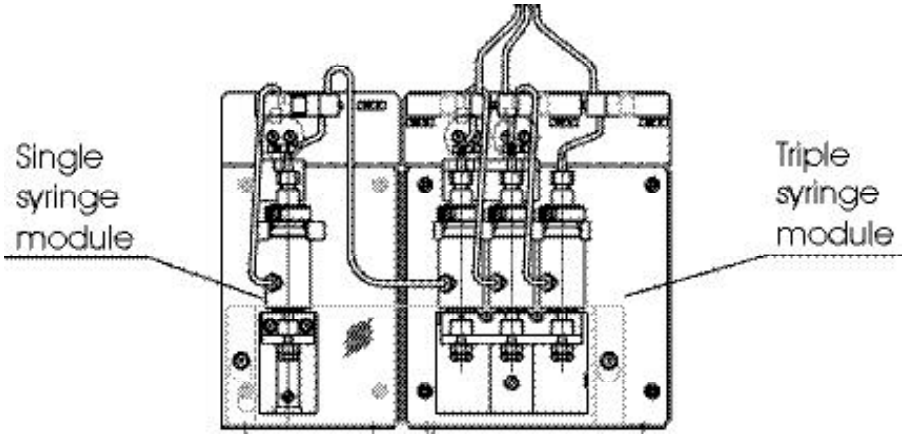
ISE module is equipped by two syringe modules:

a. the triple syringe module

b. the single syringe module

Figure 7.11 below shows the two syringe modules

Figure 7.11 - single syringe and triple syringe modules



The plungers of the three syringes of the triple syringe module (sample, diluent and ref. solution) are mechanically interconnected, the three syringes are therefore filling/dispensing at the same time.

Syringes are actuated by a stepper motor and a belt.

An optical sensor with mechanical flag are used for detecting home position of the module and checking operation integrity.

If any error is detected during operation, an alarm is reported.

7.5 ISE Operating cycles description

Timing chart repoted in figures 7.13 to 7.16 describe operating cycles of the ISE module.

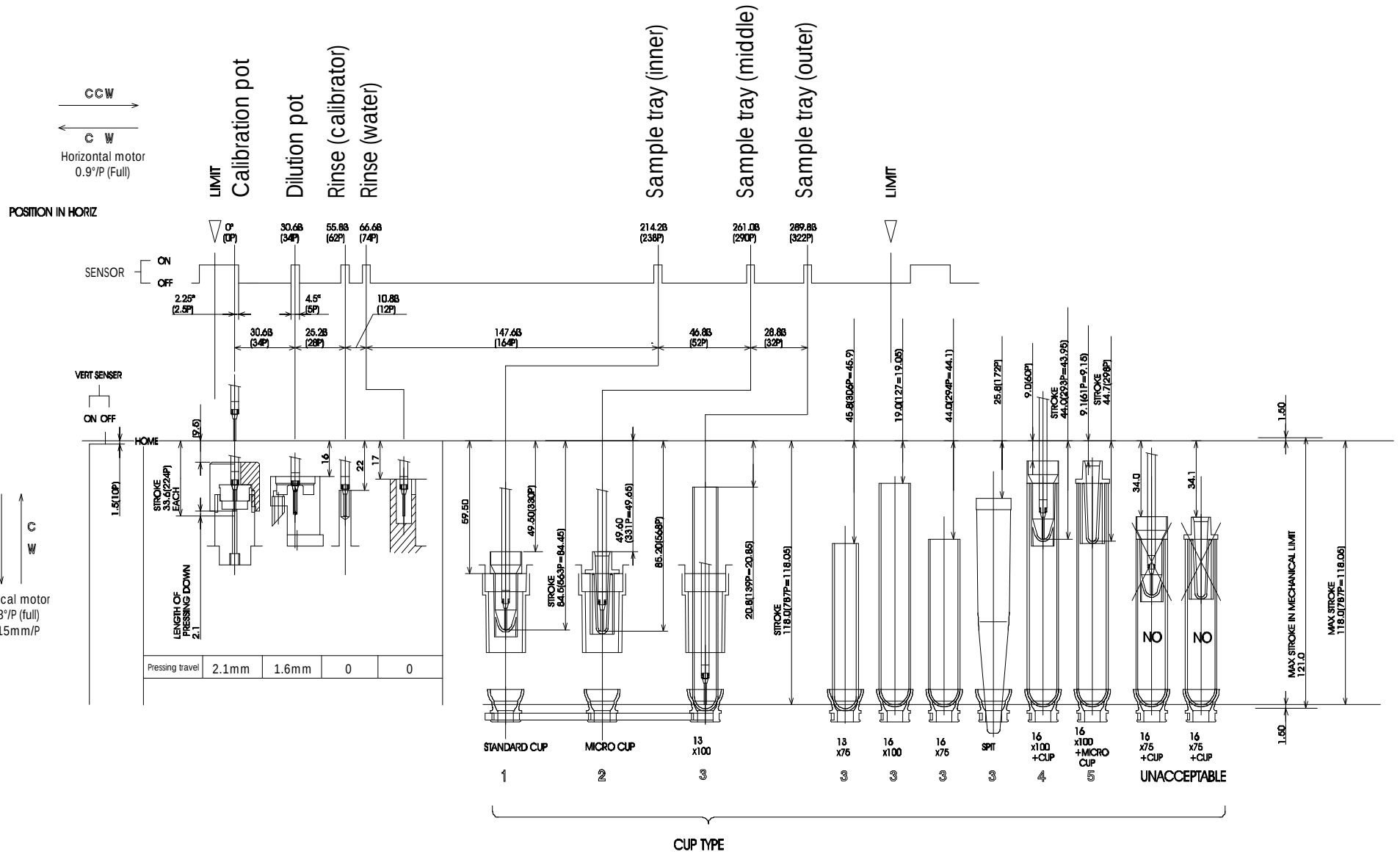
Fig 7.13 - ILab600 ISE sample analysis cycle

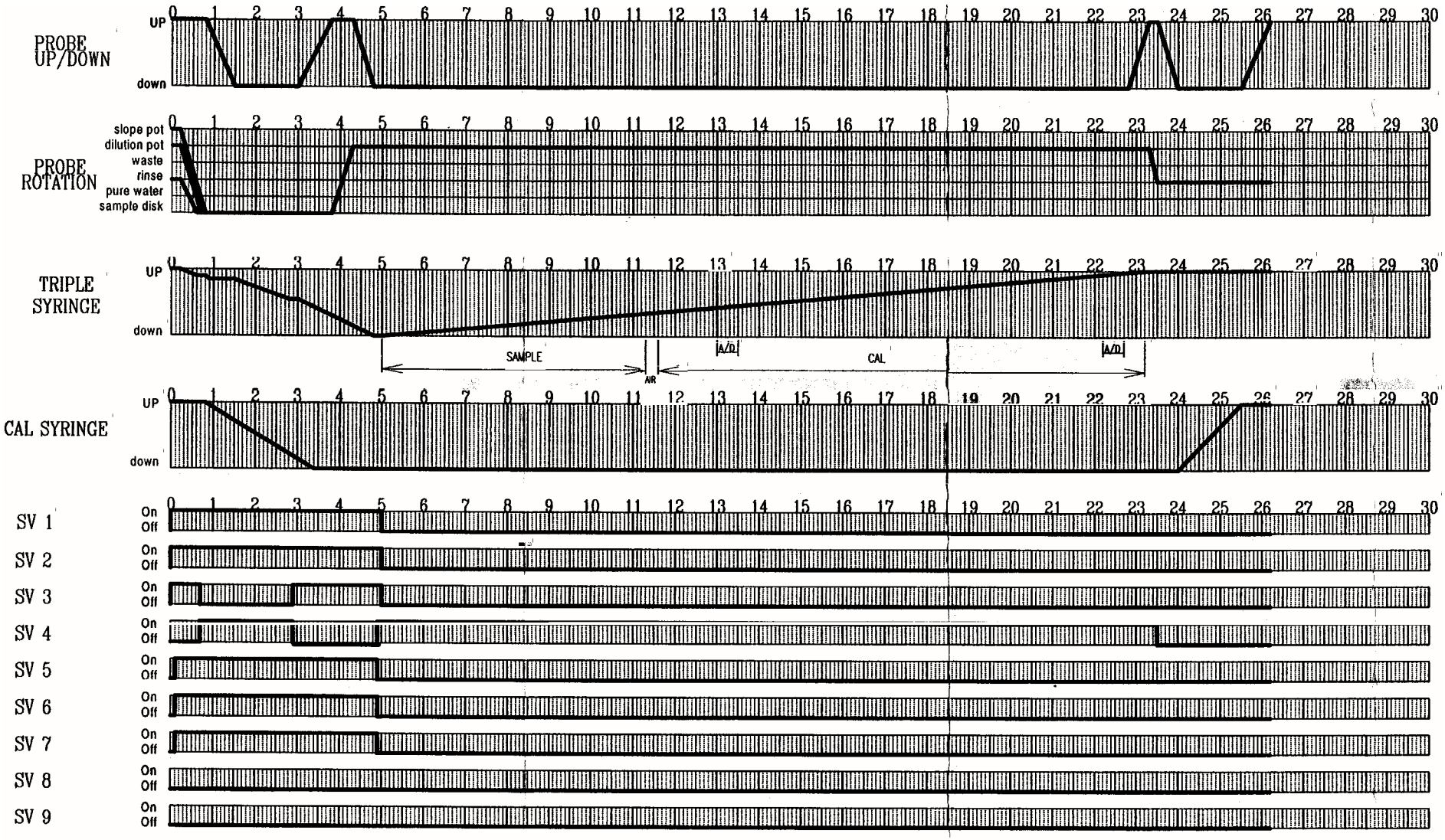
Fig 7.14 - ILab600 ISE Internal calibration cycle

Fig 7.15 - ILab600 ISE Rinse cycle

Fig 7.16 - ILab600 ISE Dummy analysis cycle

Figure 7.12 mechanical cycle




PROBE UP/DOWN
UP
down
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
PROBE ROTATION
slope pot
dilution pot
waste
rinse
pure water
sample disk
TRIPLE SYRINGE
SAMPLE
AIR
A/D
CAL
A/D
CAL SYRINGE
SV 1
SV 2
SV 3
SV 4
SV 5
SV 6
SV 7
SV 8
SV 9
On
Off

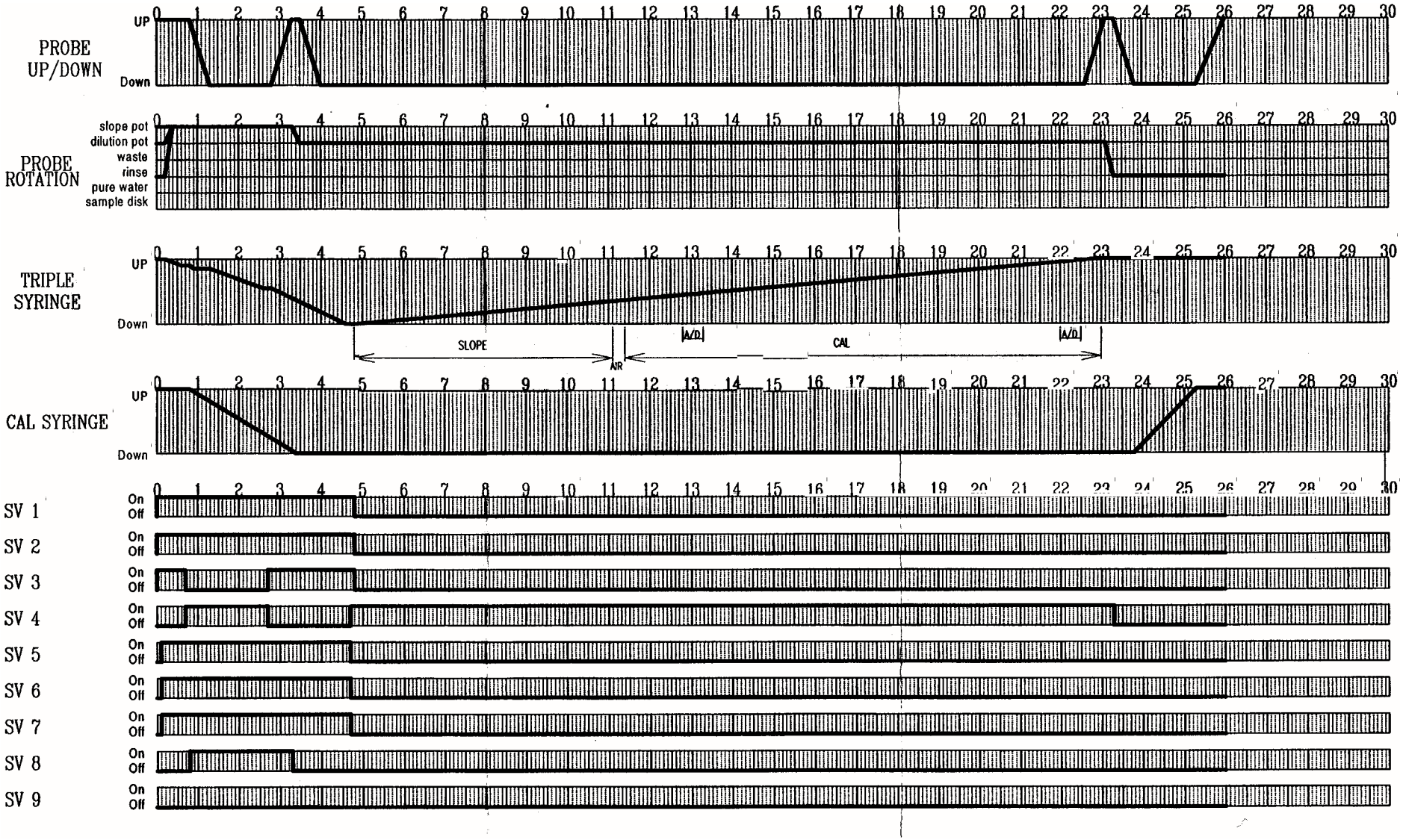

PROBE UP/DOWN
UP
Down
PROBE ROTATION
slope pot
dilution pot
waste
rinse
pure water
sample disk
TRIPLE SYRINGE
UP
Down
SLOPE
AIR
A/D
CAL
A/D
CAL SYRINGE
UP
Down
SV 1
SV 2
SV 3
SV 4
SV 5
SV 6
SV 7
SV 8
SV 9
On
Off
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Figure 7.15

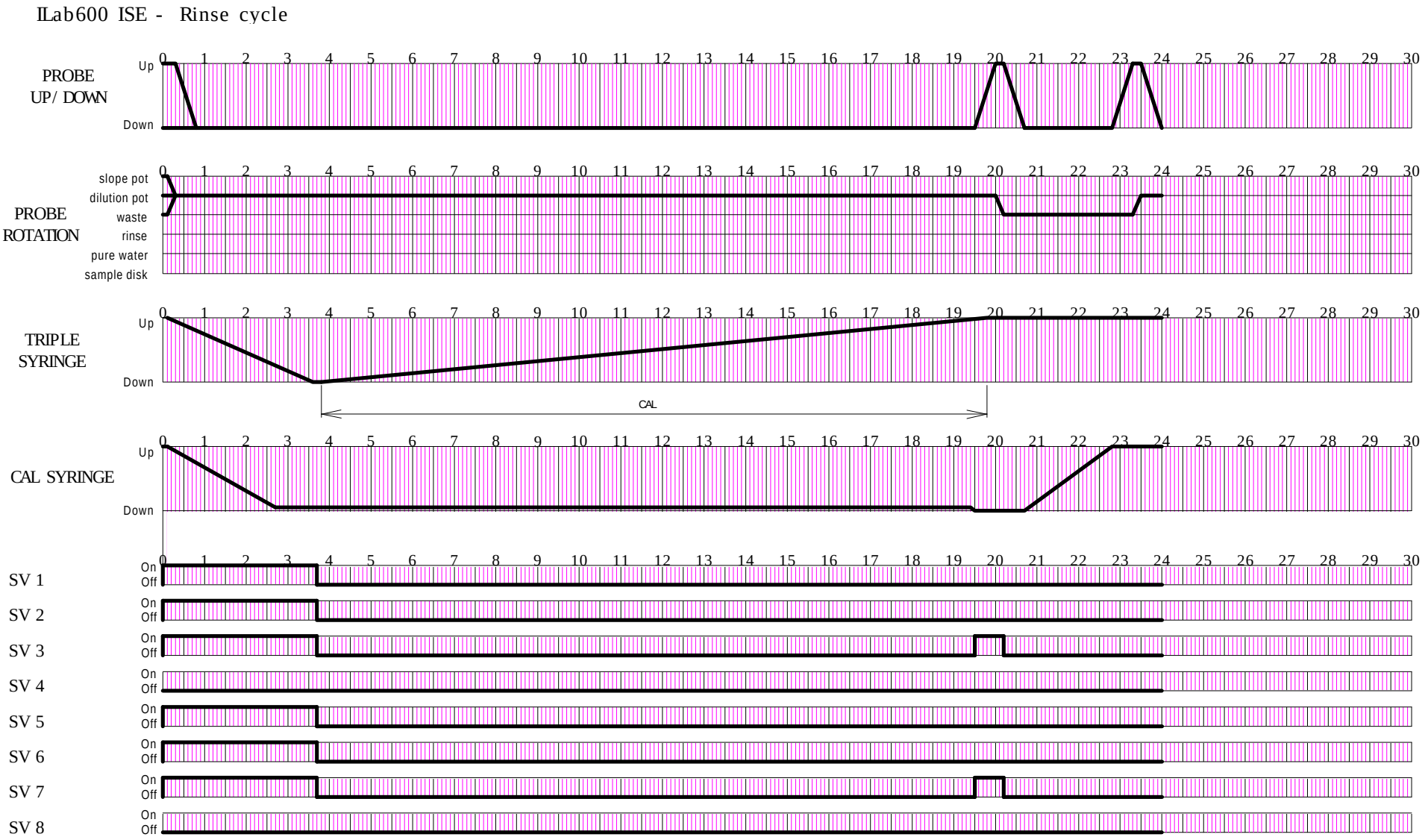
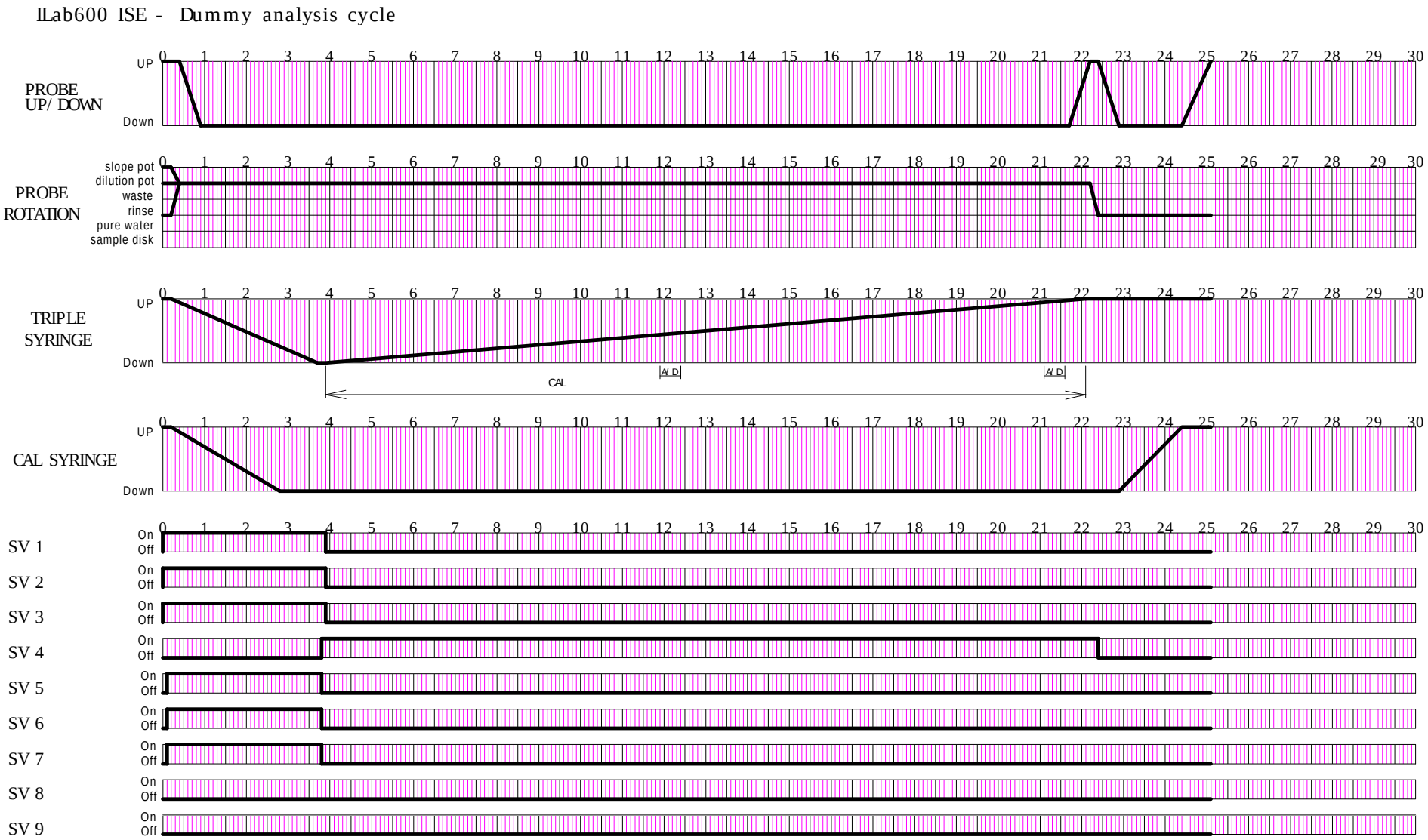

ILab600 ISE - Rinse cycle
PROBE UP/ DOWN
Up
Down
PROBE ROTATION
slope pot
dilution pot
waste
rinse
pure water
sample disk
TRIPLE SYRINGE
Up
Down
CAL
CAL SYRINGE
Up
Down
SV 1
SV 2
SV 3
SV 4
SV 5
SV 6
SV 7
SV 8
On
Off
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Figure 7.16


ILab600 ISE - Dummy analysis cycle
PROBE UP/ DOWN
UP
Down
PROBE ROTATION
slope pot
dilution pot
waste
rinse
pure water
sample disk
TRIPLE SYRINGE
A/ D
CAL
CAL SYRINGE
SV 1
SV 2
SV 3
SV 4
SV 5
SV 6
SV 7
SV 8
SV 9
On
Off
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

7.6.1 Electronic adjustments

7.6.1.1 ISE Main pcb - Setting and use of DIP switches and LEDs

7.6.1.1.a Default configurations

DIP switch S1:

S1-1: ON

S1-2: OFF

S1-3: ON

S1-4: OFF

DIP switch S2:

All OFF

Dip switch S3:

All OFF

7.6.1.1.b Use of local Diagnostic program

A local diagnostic program resident on EPROM is available, and can be set by DIP switch S3. The local diagnostic program allows some features useful for service activity, as:

- to perform mechanical/fluidical operations (move motors, switch ON solenoid valves, etc

- monitor (on LEDs) sensors status in real time

- report error conditions by LEDs code.

The local diagnostic can be enabled and used as follows:

a. Set dip SW 3-7 ON

Note: dip SW 3-7 set the ISE module for routine mode (SW 3-7 OFF) or diagnostic mode (SW 3-7 ON). When it is set for routine use all othes SW switches (SW 3-8 and SW 1 to 6) are disabled.

Note: no Reset is required after dip SW 3-7 has been set ON

b. Set the operation to be performed by configuring dip SW 3-1 to 3-6 (refer to tables below)

c. Perform the operation by operating SW 3-8 (from ON to OFF or from OFF to ON indifferently, SW 3-8 works as a toggle switch).

Note: If an error is detected by the system while performing an operation, the next commands will not be performed.

S3-1	S3-2	S3-3	S3-4	S3-5	S3-6	function	
OFF	OFF	OFF	OFF	OFF	OFF	initialize all motors	
ON	OFF	OFF	OFF	OFF	OFF	initialize probe	
OFF	ON	OFF	OFF	OFF	OFF	initialize triplet syringe	
ON	ON	OFF	OFF	OFF	OFF	initialize cal syringe	
OFF	OFF	OFF	ON	OFF	-	rotate probe to slope pot	**See note 1**
ON	OFF	OFF	ON	OFF	-	rotate probe to dilution pot	**See note 1**
OFF	ON	OFF	ON	OFF	-	rotate probe to waste	**See note 1**
ON	ON	OFF	ON	OFF	-	rotate probe to rinse	**See note 1**
OFF	OFF	ON	ON	OFF	-	rotate probe to pure water	**See note 1**
ON	OFF	ON	ON	OFF	-	rotate probe to sample disk-in	**See note 1**
OFF	ON	ON	ON	OFF	-	rotate probe to sample disk-mid	**See note 1**
ON	ON	ON	ON	OFF	-	rotate probe to sample disk-out	**See note 1**
OFF	OFF	OFF	OFF	ON	OFF	up/down probe to top	
ON	OFF	OFF	OFF	ON	OFF	up/down probe to mid	
OFF	ON	OFF	OFF	ON	OFF	up/down probe to bottom	
OFF	OFF	OFF	ON	ON	OFF	up/down triplet syringe to top	
ON	OFF	OFF	ON	ON	OFF	up/down triplet syringe to mid	
OFF	ON	OFF	ON	ON	OFF	up/down triplet syringe to bottom	
ON	ON	OFF	ON	ON	OFF	up/down cal syringe to top	
OFF	OFF	ON	ON	ON	OFF	up/down cal syringe to mid	
ON	OFF	ON	ON	ON	OFF	up/down cal syringe to bottom	
OFF	OFF	OFF	OFF	OFF	ON	SV1	**See note 2**
ON	OFF	OFF	OFF	OFF	ON	SV2	**See note 2**
OFF	ON	OFF	OFF	OFF	ON	SV3	**See note 2**
ON	ON	OFF	OFF	OFF	ON	SV4	**See note 2**
OFF	OFF	ON	OFF	OFF	ON	SV5	**See note 2**
ON	OFF	ON	OFF	OFF	ON	SV6	**See note 2**
OFF	ON	ON	OFF	OFF	ON	SV7	**See note 2**
ON	ON	ON	OFF	OFF	ON	SV8	**See note 2**
OFF	OFF	OFF	OFF	ON	ON	SV9	**See note 2**
OFF	ON	ON	ON	ON	ON	adjust probe rotationset excitation pattern of starting point	

S3-1	S3-2	S3-3	S3-4	S3-5	S3-6	function
ON	ON	ON	ON	ON	ON	check sensors (monitor in real time sensor status on LED as per table below)

LED	Sensor	Purpose	
D4	ref reagent bottle sensor	on:detect reagent	off:no reagent
D5	diluent reagent bottle sensor	on:detect reagent	off:no reagent
D6	cal reagent bottle sensor	on:detect reagent	off:no reagent
D7	probe shock sensor	on:sensor on	off:sensor off
D8	probe rotation sensor	on:sensor on	off:sensor off
D9	probe up/down sensor	on:sensor on	off:sensor off
D10	cal syringe sensor	on:sensor on	off:sensor off
D11	triplet syringe sensor	on:sensor on	off:sensor off

Note 1: S3-6 OFF Set the excitation of probe up/down motor OFF. S3-6 ON Set the excitation of probe up/down motor ON after rotation. This command is active after rotation

Note 2: 5 times on/off solenoid valve interval of 1second (on 1second,off 1second)

LED STATUS O= led on X= led off B= led blinking

LED D4 D6 D8 D10 D5 D7 D9 D11	status	error code
O O O O O X X X	starting up -	no error condition
O X O O O X X X	normal -	no error condition
B B B B B B B B	emergency stop by command -	no error condition
List of LED error conditions		
O O O O X X X O	ram error	Start-up error
O O O O X X O O	electrical circuit error	Start-up error
O O O O O O O O	cpu reset	Abnormal condition
X X X X X X X O	serial communication data format error	$01
X X X X X X O X	serial communication data number error	$02
X X X X X X O O	serial communication bcc error	$03
X X X X X O X X	serial communication over run error	$04
X X X X X O X O	serial communication framing error	$05
X X X X X O O O	a/d conversion time out (Na)	$07
X X X X O X X X	a/d conversion time out (K)	$08
X X X X O X X O	a/d conversion time out (Cl)	$09
X X X X O X O X	a/d conversion time out (Ref)	$0A
X X X X O X O O	a/d conversion time out (RS1)	$0B
X X X X O O X X	a/d conversion time out (RS2)	$0C
X X X X O O X O	a/d conversion time out (RS3)	$0D
X X X X O O O X	a/d conversion time out (RS4)	$0E
X X X X O O O O	a/d conversion time out (GND)	$0F
X X X O X X X X	a/d conversion data error (Na)	$10
X X X O X X X O	a/d conversion data error (K)	$11
X X X O X X O X	a/d conversion data error (Cl)	$12
X X X O X X O O	a/d conversion data error (Ref)	$13
X X X O X O X X	a/d conversion data error (RS1)	$14
X X X O X O X O	a/d conversion data error (RS2)	$15
X X X O X O O X	a/d conversion data error (RS3)	$16
X X X O X O O O	a/d conversion data error (RS4)	$17
X X X O O X X X	a/d conversion data error (GND)	$18

LED STATUS O= led on X= led off B= led blinking

D4 D6 D8 D10 D5 D7 D9 D11	status	error code
X X X O O O O O	probe error up/down sensor on during rotation	$1F
X X O X X X X X	probe rotation error sensor on 40 pulse at initialization	$20
X X O X X X X O	probe rotation error backlash 5 pulse at initialization	$21
X X O X X X O X	probe rotation error sensor off 328 pulse at initialization	$22
X X O X X X O O	probe rotation error sense 9 sectors (position) at initialization	$23
X X O X X O X X	probe rotation error sensor on between slope pot and dilution pot rotating left	$24
X X O X X O X O	probe rotation errorsensor off at dilution pot rotating left	$25
X X O X X O O X	probe rotation errorsensor on between dilution pot and waste rotating left	$26
X X O X X O O O	probe rotation errorsensor off at waste rotating left	$27
X X O X O X X X	probe rotation error sensor on between waste and rinse rotating left	$28
X X O X O X X O	probe rotation error sensor off at rinse rotating left	$29
X X O X O X O X	probe rotation error sensor on between rinse and pure water rotating left	$2A
X X O X O X O O	probe rotation error sensor off at pure water rotating left	$2B
X X O X O O X X	probe rotation error sensor on between pure water and disk-in rotating left	$2C
X X O X O O X O	probe rotation error sensor off at disk-in rotating left	$2D
X X O X O O O X	probe rotation error sensor on between disk-in and disk-mid rotating left	$2E
X X O X O O O O	probe rotation error sensor off at disk-mid rotating left	$2F
X X O O X X X X	probe rotation error sensor on between disk-mid and disk-out rotating left	$30
X X O O X X X O	probe rotation error sensor off at disk-out rotating left	$31
X X O O X X O X	probe rotation error sensor on between disk-out and disk-mid rotating right	$32
X X O O X X O O	probe rotation error sensor off at disk-mid rotating right	$33
X X O O X O X X	probe rotation error sensor on between disk-mid and disk-in rotating right	$34
X X O O X O X O	probe rotation error sensor off at disk-in rotating right	$35

LED STATUS O= led on X= led off B= led blinking

D4 D6 D8 D10 D5 D7 D9 D11	status	error code
X X O O X O O X	probe rotation error sensor on between disk-in and pure water rotating right	$36
X X O O X O O O	probe rotation error sensor off at pure water rotating right	$37
X X O O O X X X	probe rotation error sensor on between pure water and rinse rotating right	$38
X X O O O X X O	probe rotation error sensor off at rinse rotating right	$39
X X O O O X O X	probe rotation error sensor on between rinse and waste rotating right	$3A
X X O O O X O O	probe rotation error sensor off at waste rotating right	$3B
X X O O O O X X	probe rotation error sensor on between waste and dilution pot rotating right	$3C
X X O O O O X O	probe rotation error sensor off at dilution pot rotating right	$3D
X X O O O O O X	probe rotation error sensor on between dilution pot and slope pot rotating right	$3E
X X O O O O O O	probe rotation error sensor off at slope pot rotating right	$3F
X O X X X X X X	probe up/down errorsensor on 1640 pulse at initialization	$40
X O X X X X X O	probe up/down error sensor off 80 pulse at initialization	$41
X O X X X X O X	probe up/down error backlash 20 pulse at initialization	$42
X O X X X X O O	probe error rotation sensor off during up/down	$43
X O X X X O X X	probe up error sensor unusualy off at slope pot	$44
X O X X X O X O	probe up error sensor not turns off at slope pot	$45
X O X X X O O X	probe up error sensor unusualy on at slope pot	$46
X O X X X O O O	probe down error sensor unusualy on at slope pot	$47
X O X X O X X X	probe down error sensor unusualy off at slope pot	$48
X O X X O X X O	probe up error sensor unusualy off at dilution pot	$49
X O X X O X O X	probe up error sensor not turns off at dilution pot	$4A
X O X X O X O O	probe up error sensor unusualy on at dilution pot	$4B
X O X X O O X X	probe down error sensor unusualy on at dilution pot	$4C
X O X X O O X O	probe down error sensor unusualy off at dilution pot	$4D
X O X X O O O X	probe up error sensor unusualy off at waste	$4E
X O X X O O O O	probe up error sensor not turns off at waste	$4F
X O X O X X X X	probe up error sensor unusualy on at waste	$50

LED STATUS O= led on X= led off B= led blinking

D4 D6 D8 D10 D5 D7 D9 D11	status	error code
X O X O X X X O	probe down error sensor unusualy on at waste	$51
X O X O X X O X	probe down error sensor unusualy off at waste	$52
X O X O X X O O	probe up error sensor unusualy off at rinse	$53
X O X O X O X X	probe up error sensor not turns off at rinse	$54
X O X O X O X O	probe up error sensor unusualy on at rinse	$55
X O X O X O O X	probe down error sensor unusualy on at rinse	$56
X O X O X O O O	probe down error sensor unusualy off at rinse	$57
X O X O O X X X	probe up error sensor unusualy off at pure water	$58
X O X O O X X O	probe up error sensor not turns off at pure water	$59
X O X O O X O X	probe up error sensor unusualy on at pure water	$5A
X O X O O X O O	probe down error sensor unusualy on at pure water	$5B
X O X O O O X X	probe down error sensor unusualy off at pure water	$5C
X O X O O O X O	probe up error sensor unusualy off at disk-in	$5D
X O X O O O O X	probe up error sensor not turns off at disk-in	$5E
X O X O O O O O	probe up error sensor unusualy on at disk-in	$5F
X O O X X X X X	probe down errorsensor unusualy on at disk-in	$60
X O O X X X X O	probe down error sensor unusualy off at disk-in	$61
X O O X X X O X	probe up error sensor unusualy off at disk-mid	$62
X O O X X X O O	probe up error sensor not turns off at disk-mid	$63
X O O X X O X X	probe up error sensor unusualy on at disk-mid	$64
X O O X X O X O	probe down error sensor unusualy on at disk-mid	$65
X O O X X O O X	probe down error sensor unusualy off at disk-mid	$66
X O O X X O O O	probe up error sensor unusualy off at disk-out	$67
X O O X O X X X	probe up error sensor not turns off at disk-out	$68
X O O X O X X O	probe up error sensor unusualy on at disk-out	$69
X O O X O X O X	probe down error sensor unusualy on at disk-out	$6A
X O O X O X O O	probe down error sensor unusualy off at disk-out	$6B
X O O X O O X X	probe errorsense shock	$6C
X O O X O O X O	probe error shock sensor not turns on at sensing down limit	$6D
X O O O X X X X	triplet syringe error sensor on 3600 pulse at initialization	$70
X O O O X X X O	triplet syringe error sensor off 500 pulse at initialization	$71

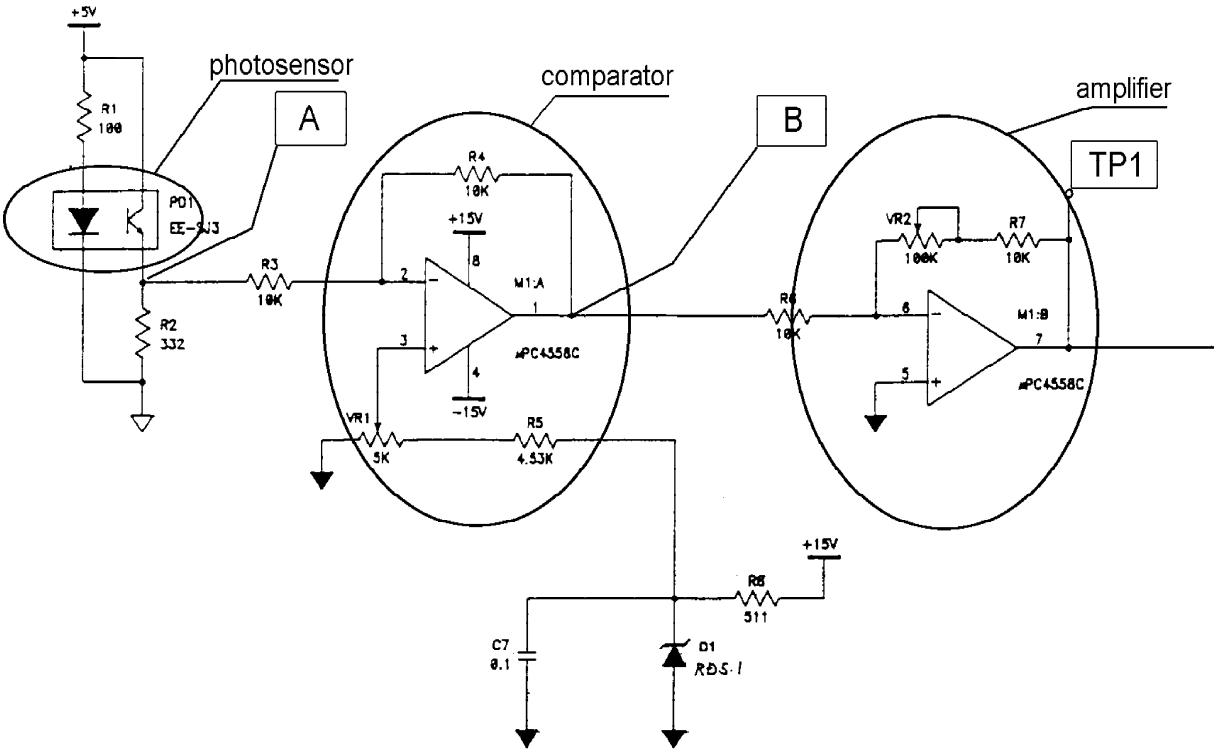
LED STATUS O= led on X= led off B= led blinking

D4 D6 D8 D10 D5 D7 D9 D11	status	error code
X O O O X X O X	triplet syringe error backlash 100 pulse at initialization	$72
X O O O X X O O	triplet syringe up error sensor unusualy off	$73
X O O O X O X X	triplet syringe up error sensor not turns off	$74
X O O O X O X O	triplet syringe up error sensor unusualy on	$75
X O O O X O O X	triplet syringe down error sensor unusualy on	$76
X O O O X O O O	triplet syringe down error sensor unusualy off	$77
O X X X X X X X	cal syringe error sensor on 2156 pulse at initialization	$80
O X X X X X X O	cal syringe error sensor off 395 pulse at initialization	$81
O X X X X X O X	cal syringe error backlash 60 pulse at initialization	$82
O X X X X X O O	cal syringe up error sensor unusualy off	$83
O X X X X O X X	cal syringe up error sensor not turns off	$84
O X X X X O X O	cal syringe up error sensor unusualy on	$85
O X X X X O O X	cal syringe down error sensor unusualy on	$86
O X X X X O O O	cal syringe down error sensor unusualy off	$87
O X X O X X X X	samplig time out error	$90
O O X X X X X X	short sample	$C0

7.6.1.2 Check-out and adjustment of liquid level sensor circuitries

This procedure can be used for adjusting all the circuitries of liquid sensors of Reference, Calibrator, Diluent and Slope solutions. Circuitry are resident in Reagent 1 sens pcb and Reagent 2 sens pcb. Refr to fig 7.17 below:

Figure 7.17 - Liquid level sensor



a. measure voltage at TP1. With tubing filled by air TP1 should be 0VDC +/- 100mV.

b. With tubing filled by liquid TP1 should be + 3VDC +/- 100mV. If not adjust trimmer VR2, then repeat step a.

7.6.1.3 Test points of ISE Main pcb

TP 1: Electric potential of the Na electrode. Equivalent to the TP 1 on the preamplifier board.

TP 2: Electric potential of the K electrode. Equivalent to the TP 2 on the preamplifier board.

TP 3: Electric potential of the Cl electrode. Equivalent to the TP 3 on the preamplifierÄ board.

TP 4: Electric potential of the ref. electrode. Equivalent to the TP 7 on the preamplifier board.

TP 5: Output of the electric potential of the Na electrode subtracted by the electric potential of the reference

electrode amplified by 20 times

TP 6: Output of the electric potential of the K electrode subtracted by the electric potential of the reference electrode amplified by 20 times

TP 7: Output of the electric potential of the Cl electrodesubtracted by the electric potential of the reference electrode" amplified by 20 times

TP 8: Output from the calibrator liquid sensor. Equivalent to the TP1 on the Liquid sensor 1 PCB ASSY.

TP 9: Output from the diluent liquid sensor. Equivalent to the TP 2 on the Liquid sensor 1 PCB ASSY.

TP 10: Output from the Ref solution liquid sensor. Equivalent to the TP 3 on the Liquid sensor 1 PCB ASSY.

TP 11: Output from the slope solution liquid sensor. Equivalent to the TP 1 on the Liquid sensor 2 PCB ASSY.

TP 12: +5 VDC power supply for the digital circuit

TP 13: Digital ground (+5 VDC ground)

TP 14: +24 VDC power supply for driving motors and solenoid valves

TP 15: Power ground (+24 VDC ground)

TP 16: +15 VDC power supply for the analog circuit

TP 17: Analog ground (+ 15 VDC ground)

TP 18: -15 VDC power supply for the analog circuit

TP 19: +12 VDC power supply for the current loop

TP 20: V/F converter output

TP 21: CPU reset output H while the CPU is reset

TP 22: CPU reset input The CPU is reset while the input is L.

TP 23: CPU clock: 4 MHz at the TTL level

7.6.1.4 Test points of Liquid sensor 1 pcb

TP 1: Output from the liquid seasor inside the piping for the calibrator

TP 2: Output from the liquid sensor inside the piping for the diluent

TP 3: Output from the liquid sensor inside the piping for the reference solution

TP 4: Analog ground

7.6.1.5 Test points of Liquid sensor 2 pcb

TP 1: Output from the liquid sensor inside the piping for the slope solution

TP 2: Analog ground

7.6.1.6 Test points of Preamplifier pcb

TP 1: Electric potential of the sodium (Na) electrode

TP 2: Electric potential of the potassium (K) electrode

TP 3: Electric potential of the chloride (Cl) electrode

TP 4: Output equivalent to ”the electric potential of the Na electrode subtracted by the electric potential of the reference electrode amplified by 20 times

TP 5: Output equivalent to ”the electric potential of the K electrode subtracted by the electric potential of the reference electrode” amplified by 20 times

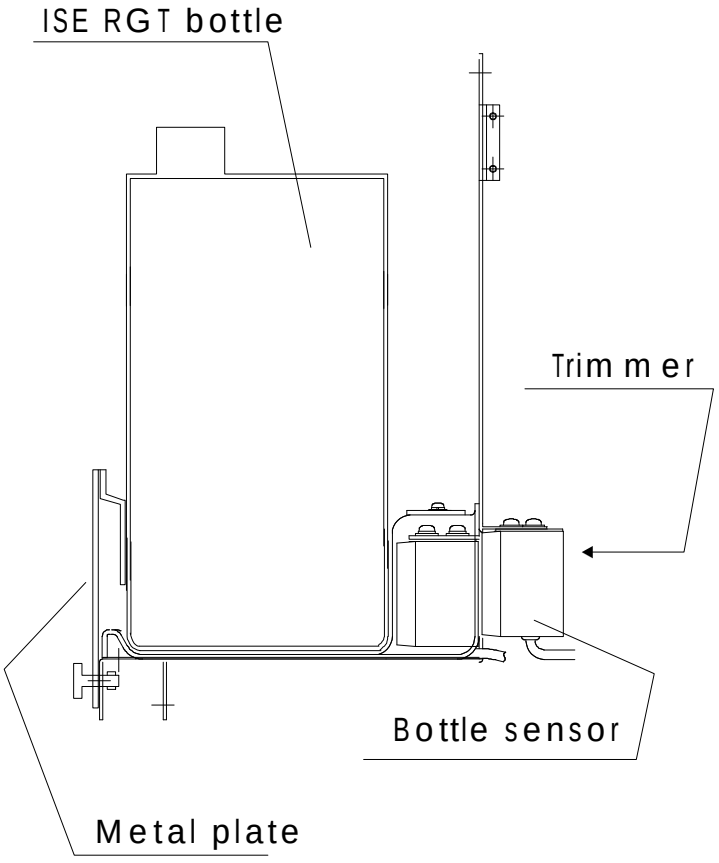
TP 6: Output equivalent to ”the electric potential of the Cl electrode subtracted by the electric potential of the reference electrode amplified by times

TP 7: Electric potential of the reference electrode

TP 8: Analog ground

7.6.1.7 Bottle level sensors checkout and adjustment

Figure 7.18 - Bottle sensors



The ISE module is provided of three level sensor for the detection of liquid in ISE Diluent , ISE Reference Solution and ISE Calibrator bottles. The sensor detects whenever the actual liquid level is higher or lower than a set level, and triggers a reference signal for monitoring the ISE bottles status in the reagent map.

The operation checkout and the adjustment of each sensor can be performed as follows (note: the ILab system is turned ON and is in Ready status):

a. Remove the complete tray that hold the ISE RGT bottles.

b. Fill an empty bottle with the set volume 1 (125 or 250ml) of distilled water as indicated in table below. Place the bottle on the tray, place the metal plate in its housing and verify that the status of the bottle level sensor.

Note: if the metal plate is not properly in place the bottle level sensor cannot detect any presence of liquid in the bottle.

Note: The status of the bottle level sensor is monitored by an LED located on the sensor itself as follows:
as sensor is detecting liquid led is ON
as sensor is detecting air led is OFF

Note: Make sure that the tray with the ISE RGT bottle is flat with the floor.

c. The LED of the liquid sensor should be ON. The adjustment of the sensor can be performed by turning the sensor trimmer until the LED is switched OFF, then carefully turn again the trimmer to LED and setting the position of the trimmer where the LED has just switched from OFF to ON.

d. Drain the bottle and fill with the set volume 2 (75 or 150ml) of distilled water as indicated in table below. Verify that at this time the sensor LED is OFF. If not repeat step c.

	Cal & Ref Sol bottles	**Diluent bottle**
H2O dist. Volume 1	125 ml	250 ml
H2O dist. Volume 2	75 ml	150 ml

7.6.2 Mechanical check-out and alignments

7.6.2.1 Vertical alignment of ISE sample probe module

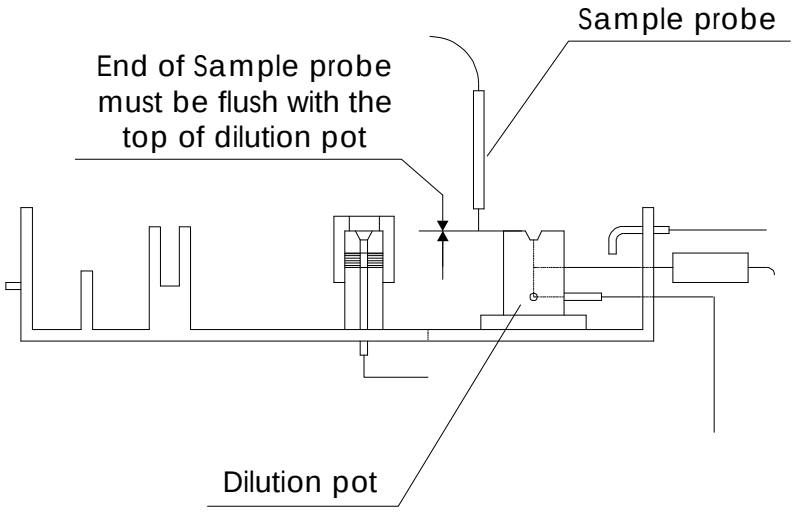
The vertical alignment of the ISE sample probe should be checked and performed with the ILab600 system turned ON.

a. Enter in the ISE diagnostic program. Set the vertical position of the ISE sample probe to MIDDLE.

b. Set the rotational probe arm to FREE. Manually rotate the probe to the Dilution pot.

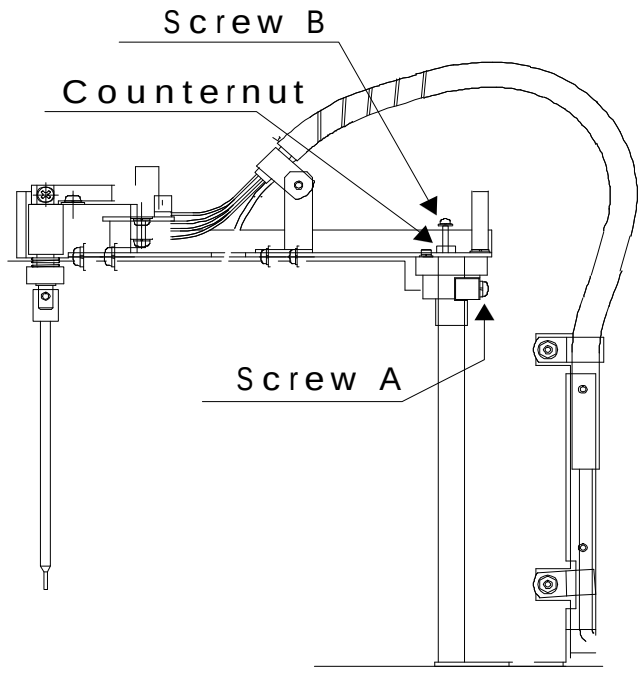
c. Check that the tip of the sample probe be flush with the top border of the Detergent pot.

Figure 7.19 - ISE sample probe



d. If not adjust the height of the arm by loosening the fixing screws of the arm and setting the vertical screw and counternut

Fig 7.20 - ISE spl probe arm



Note: After the vertical alignment has been changed, check that during the operation the rotational position has not been misaligned. By the service program move the rotational position of the probe arm to the Calibration pot, then set the vertical operation to FREE. Manually push the probe into the Calibration pot If the probe is not centered into the Calibration pot loosen again the fixing screw and align horizontally the probe as required.

7.6.2.2 Magnetization pattern alignment (electronic home)

Set magnetization pattern as follows:

a. Set Dip Switch SW3 of the ISE Main CPU pcb as follows:

bit 1 OFF

bit 2 to 6 ON

bit 7 ON

b. change position of bit 8 to start the procedure.

After a short mechanical inizialization, check status of LEDs D4 to D11. Should any LED be flashing, set corresponding bits 2, 3 and 4 of Dip Switch SW 2 until all LEDs are OFF.

c. Repeat a few more times the magnetization pattern (step b.) and verify that LEDs are constantly all OFF.

d. Return to Routine mode by setting all bits of Dip Switch SW3 OFF. Enter in the diagnostic program and Reset the ISE module.

7.6.3 Further checkouts

7.6.3.1 Electrode typical offset

Electrodes performances can be evaluated by checking the mV offset.

Here below are reported the typical mV offset of internal calibration considering a calculated Coefficient Factor = 1.

Typical electrode offset on calibration with C.F. = 1

	Na	K	Cl
High cal	3.26	8.60	113.31
Low cal	-1.66	-1.66	119.97
Difference	4.92	10.26	-6.66

Note: unit is mV

7.6.3.1 Cleaning the mixer

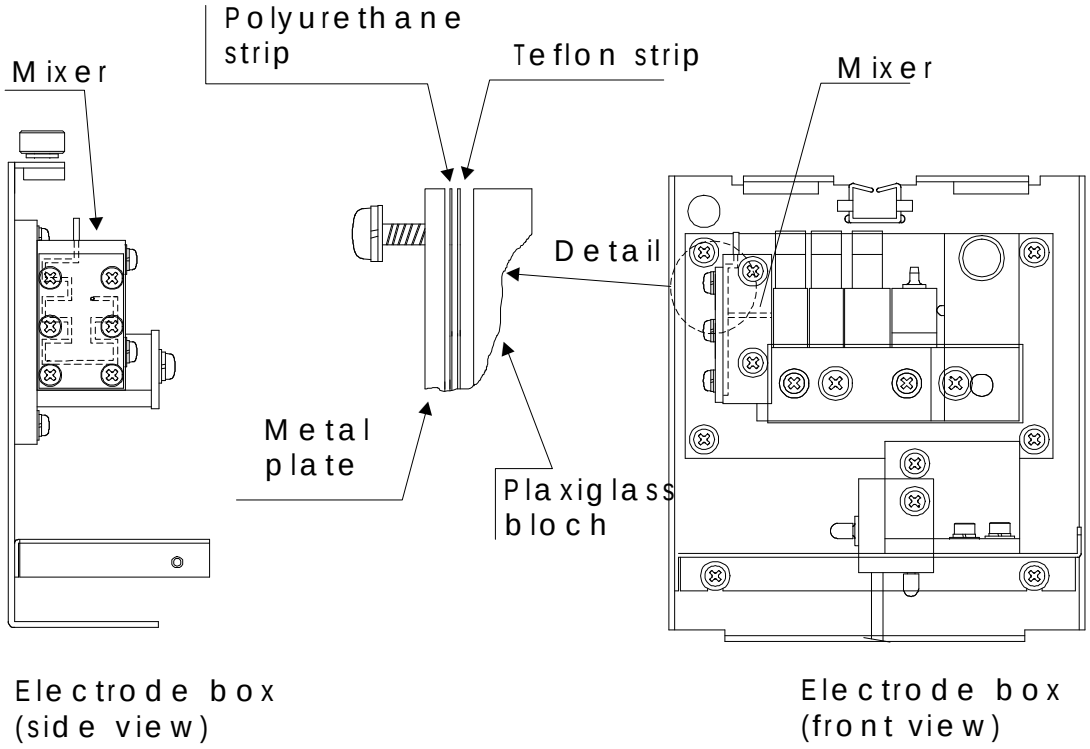
The ISE module is equipped by two mixers: the first is located at the side of the tray of Diluent/calibration pots (see fig 22), the second is located in the electrode box (see fig. 21).

If required, mixer may be cleaned as follows:

a. Remove the mixer from the system (two screws)

b. Remove the metal plate

Figure 7.21 - ISE mixer 2



c. Clean carefully the mixer fluidic path with detergent solution. Rinse with distilled water

d. Remove and discard the old polyurethane strip and the teflon strip. Install new polyurethane and teflon strips

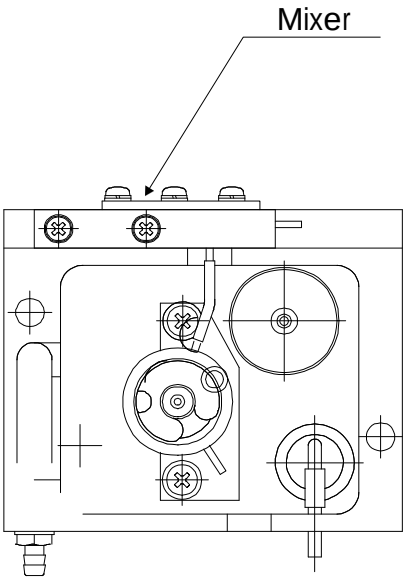
e. Install the metal plate. Do not overtighten the six fixing screws. Screws should be tightened with the same strenght.

f. Replace the mixer in its housing.

Note: The polyurethane and teflon strips should be replaced with new ones any time that the metal plate is removed.

Note: cleaning procere is the same for both the mixers

Figure 7.22 - ISE mixer 1



8 Troubleshooting

8.1 Error Dictonary

Any ILab600 system hardware and software operation is monitored by dedicated system integrity check.

If any error is detected, specific alarm is generated and reported by the ILab600.

Whenever an error is reported, the system beeps intermittently, and a red arrow is shown besides the ! (exclamation mark) icon.

Error message is coded as follows:

- error code (numeric): is a six digit code, the first (from left) two digit indicate the area or module of the error, as follows:

  01: Photometer/cuvette tray

  02: Sample tray/sample dispenser

  03: Reagent tray/reagent 1 dispenser

  04: Reagent 2 dispenser/sample cup stirrer

  05: Cuvette stirrer/cuvette rinse

  09: ISE

  0a: Other

Complete error dictionary is reported in next pages

Error Code	Parameter1	Parameter2	Error description	Location of the problem	Note
000101	01		Command cannot be executed	photometer, cuvette tray	Timing mismatch between modules-SW conflict
000101	02		Command cannot be executed	sample tray, sample dispenser	Timing mismatch between modules-SW conflict
000101	03		Command cannot be executed	RGT tray, R1 dispenser	Timing mismatch between modules-SW conflict
000101	04		Command cannot be executed	R2 dispenser, SPL cup stirrer	Timing mismatch between modules-SW conflict
000101	05		Command cannot be executed	cuvette stirrer, cuvette wash.	Timing mismatch between modules-SW conflict
000101	06		Command cannot be executed	PID	Timing mismatch between modules-SW conflict
000101	07		Command cannot be executed	RID	Timing mismatch between modules-SW conflict
000101	08		Command cannot be executed	Timer	Timing mismatch between modules-SW conflict
000101	09		Command cannot be executed	ISE	Timing mismatch between modules-SW conflict
000102	01		Failure executing command	photometer, cuvette tray	Abnormal data transmission-SW conflict
000102	02		Failure executing command	sample tray, sample dispenser	Abnormal data transmission-SW conflict
000102	03		Failure executing command	RGT tray, R1 dispenser	Abnormal data transmission-SW conflict
000102	04		Failure executing command	R2 dispenser, SPL cup stirrer	Abnormal data transmission-SW conflict
000102	05		Failure executing command	cuvette stirrer, cuvette wash.	Abnormal data transmission-SW conflict
000102	06		Failure executing command	PID	Abnormal data transmission-SW conflict
000102	07		Failure executing command	RID	Abnormal data transmission-SW conflict
000102	08		Failure executing command	Timer	Abnormal data transmission-SW conflict
000102	09		Failure executing command	ISE	Abnormal data transmission-SW conflict
000103	01		Time-out executing command	photometer, cuvette tray	Abnormal data transmission-SW conflict
000103	02		Time-out executing command	sample tray, sample dispenser	Abnormal data transmission-SW conflict
000103	03		Time-out executing command	RGT tray, R1 dispenser	Abnormal data transmission-SW conflict
000103	04		Time-out executing command	R2 dispenser, SPL cup stirrer	Abnormal data transmission-SW conflict
000103	05		Time-out executing command	cuvette stirrer, cuvette wash.	Abnormal data transmission-SW conflict
000103	06		Time-out executing command	PID	Abnormal data transmission-SW conflict
000103	07		Time-out executing command	RID	Abnormal data transmission-SW conflict
000103	08		Time-out executing command	Timer	Abnormal data transmission-SW conflict
000103	09		Time-out executing command	ISE	Abnormal data transmission-SW conflict
000110	01		No buffer space	work sheet cannot be received	PC sent a work-list without confirming the data buffer spac
000110	02		No buffer space	data cannot be stored	PC not sending data-request
000110	03		No buffer space	ISE data cannot be stored	PC not sending ISE data-request
000110	04		No buffer space	error info cannot be stored	PC not sending error-request
000120	01		ROM card access abnormal (except for routine)	no ROM card	ROM card is ejected
000120	02		ROM card access abnormal (except for routine)	Write protected	ROM card is write-protected
000120	03		ROM card access abnormal (except for routine)	Write voltage error	ROM card malfunction
000120	04		ROM card access abnormal (except for routine)	Erase error	ROM card malfunction
000120	05		ROM card access abnormal (except for routine)	Write error	ROM card malfunction
000120	06		ROM card access abnormal (except for routine)	Time out	ROM card malfunction
000120	07		ROM card access abnormal (except for routine)	No data	no data written in ROM card
000120	08		ROM card access abnormal (except for routine)	Data size error	Read/write size is incorrect
000120	09		ROM card access abnormal (except for routine)	Not erased	ROM card is not erased
000121	00		Sensor error	Pure water tank empty	
000121	01		Sensor error	Pure water pressure switch	
000121	02		Sensor error	Degasser vacuum pressure SW	
000121	03		Sensor error	Vacuum tank level SW	
000121	04		Sensor error	Vacuum tank pressure SW	
000121	05		Sensor error	Drain tank full	

Error Code	Parameter1	Parameter2	Error description	Location of the problem	Note
000121	06		Sensor error	Reservoir water level	
000121	07		Sensor error	Cooling compartment power	
000121	08		Sensor error	5 VDC power source	power supply or fuse failure
000121	09		Sensor error	ISE 5 VDC power source	power supply or fuse failure
000121	0A		Sensor error	ISE 24 VDC power source	power supply or fuse failure
000121	0B		Sensor error	Lamp voltage	power supply or fuse failure
000121	0C		Sensor error	24 VDC-A voltage	power supply or fuse failure
000121	0D		Sensor error	24 VDC-B voltage	power supply or fuse failure
000121	0E		Sensor error	-15 VDC-B voltage	power supply or fuse failure
000121	0F		Sensor error	+15 VDC-B voltage	power supply or fuse failure
000121	10		Sensor error	+5 VDC-A voltage	power supply or fuse failure
000121	11		Sensor error	-15 VDC-A voltage	power supply or fuse failure
000121	12		Sensor error	+15 VDC-A voltage	power supply or fuse failure
000121	13		Sensor error	Main CPU +/-12 VDC	power supply or fuse failure
000121	14		Sensor error	Unit CPU-A 5VDC	power supply or fuse failure
000121	15		Sensor error	Unit CPU-B 5VDC	power supply or fuse failure
000122	00		RS232C reading error	PC connection line	PC-Ilab Connection failure
000122	01		RS232C reading error	Debugging use only	
000122	02		RS232C reading error	PID module connection line	
000122	03		RS232C reading error	RID module connection line	
000122	04		RS232C reading error	Timer module connection line	Transmission parameter mismatch
000122	05		RS232C reading error	ISE module connection line	Transmission parameter mismatch
000122		01	RS232C reading error	Parity error	Transmission parameter mismatch
000122		02	RS232C reading error	Over-run error	Transmission parameter mismatch
000122		03	RS232C reading error	Framing error	Transmission parameter mismatch
000122		04	RS232C reading error	Break detected	Transmission parameter mismatch
000122		05	RS232C reading error	Pending error (IRQ missing)	Transmission parameter mismatch
000122		10	RS232C reading error	Internal check-sum error	Transmission parameter mismatch
000122		11	RS232C reading error	Check-sum error	Transmission parameter mismatch
000122		12	RS232C reading error	No data	Transmission parameter mismatch
000122		13	RS232C reading error	Size over	Transmission parameter mismatch
000122		14	RS232C reading error	Time out	Transmission parameter mismatch
000122		15	RS232C reading error	Unit busy	Unit malfunction (timing error)
000123	00		RS232C writing error	PC connection line	PC-Ilab Connection failure
000123	01		RS232C writing error	Debugging use only	Interconnection problem
000123	02		RS232C writing error	PID module connection line	Interconnection problem
000123	03		RS232C writing error	RID module connection line	Interconnection problem
000123	04		RS232C writing error	Timer module connection line	Interconnection problem
000123	05		RS232C writing error	ISE module connection line	Interconnection problem
000123		01	RS232C writing error	Parity error	Interconnection problem
000123		02	RS232C writing error	Over-run error	Interconnection problem
000123		03	RS232C writing error	Framing error	Interconnection problem
000123		04	RS232C writing error	Break detected	Interconnection problem
000123		05	RS232C writing error	Pending error (IRQ missing)	Interconnection problem
000123		10	RS232C writing error	Internal check-sum error	Interconnection problem
000123		11	RS232C writing error	Check-sum error	Interconnection problem

Error Code	Parameter1	Parameter2	Error description	Location of the problem	Note
000123		12	RS232C writing error	No data	Interconnection problem
000123		13	RS232C writing error	Size over	Interconnection problem
000123		14	RS232C writing error	Time out	Interconnection problem
000123		15	RS232C writing error	Unit busy	Interconnection problem
000130			Pure water tank drain abnormal	Pure water tank-drain line	
000131			Pure water tank supply abnormal	Pure water supply line	
000132			Incubator water drain abnormal		
000133			Incubator water supply abnormal		
000134	00		Incubator temperature abnormal	Temperature low	
000134	01		Incubator temperature abnormal	Temperature high	
000134	02		Incubator temperature abnormal	Temperature overheat (>40°C)	
000135			Incubator water level problem (low)	Incubator	
000140			Target volume is insufficient (except for analysis period)	Sample or RGT missing	
2. Errors common to all the slave CPUs					
First two digits (from left) of Error Code indicate the CPU generatig the error as follows:					
01: Photometer/Cuvette tray					
02: Sample tray/Sample dispenser					
03: Reagent tray/Reagent 1 dispenser					
04: Reagent 2 dispenser/Sample cup stirrer					
05: Cuvette stirrer/Cuvette rinse					
2.1 List of warnings					
010001			Target volume is insufficient	Sample or RGT missing	
010003			Received another command while waiting for "Reset" command		S/W Problem
010004			Interrupt Problem		S/W Problem
010006			Command abnormal		S/W Problem
010007			Parameter abnormal		S/W Problem
010008			Level sensor problem (level detection problem)		Check for probe bent/dirty
010009			Level sensor problem (liquid section problem)		Bubbles on the surface
01000a			Level detection time is out of range (too early)		Bottle setup is incorrect (Bottle shape is wrong)
01000b			Level sensor triggered while reading down-limit		
2.2 List of errors					
010102			S-format check-sum problem (while downloading S/W from Main CPU)		H/W problem (ROM program was not copied correctly to R
010106			MPU extra RAM access problem (during starting up)		H/W problem
010107			MPU RAM access problem (during starting up)		H/W problem
010108			OP code problem		S/W Problem
3. Photometer/Cuvette tray erro					
010127			Pulse pattern problem (pulse motor) (while initializing)		
010128			Reaction disk can not be rotated		
010129			Reaction disk cannot move from initial position		
01012a			Reaction disk cannot find the original position		
01012c			Reaction disk error ; sensor 2 problem while rotating		
01012f			Fuse broken : FS6(24V)	Fuse broken	
010130			Lamp problem	Lamp disconnected	
010150			Reaction disk error ; sensor 2 problem while rotating	Sensor problem	
010152			Reaction disk rotation error ; stirrer or cuvette wash station assembly in down position (ana	Problem with the movement of stirrer assembly or cuvette wash station assembly while up/down	
010153			Reaction disk rotation error ; sample probe in down position (analyzing)	Problem with vertical movement of sample probe while up/down	

Error Code	Parameter1	Parameter2	Error description	Location of the problem	Note
010154			Reaction disk rotation error ; Reagent 2 probe in down position (analyzing)	Problem with vertical movement of Reagent 2 probe while up/down	
010155			Reaction disk rotation error ; Reagent 1 probe in down position (analyzing)	Problem with vertical movement of Reagent 1 probe while up/down	
010156			Reaction disk rotation error ; stirrer or cuvette wash station assembly in down position (oth	Problem with the movement of stirrer assembly or cuvette wash station assembly while up/down	
010157			Reaction disk rotation error ; sample probe in down position (other time)	Problem with vertical movement of sample probe while up/down	
010158			Reaction disk rotation error ; Reagent 2 probe in down position (other time)	Problem with vertical movement of Reagent 2 probe while up/down	
010159			Reaction disk rotation error ; Reagent 1 probe in down position (other time)	Problem with vertical movement of Reagent 1 probe while up/down	
01015a			Analyzing module failure	Pre-amplifier problem	
01015b			Measuring unit cannot attain "Ready" status while initializing	Pre-amplifier problem	
010180to83			Photometer/Reaction disk : time-out	S/W Problem	
4. Sample tray/sample dispens					
4.1 List of warnings					
020001			Sample tray/sample probe : Target volume insufficient	Sample is short	
020003			Sample tray/sample probe : received another command while waiting for "Reset" command	S/W Problem	
020004			Sample tray/sample probe : Interrupt problem	S/W Problem	
020006			Sample tray/sample probe : Command problem	S/W Problem	
020007			Sample tray/sample probe : Parameter problem	S/W Problem	
020008			Sample tray/sample probe : Level sensor problem (level detection problem)		
020009			Sample tray/sample probe : Level sensor problem (liquid section problem)		
02000a			Sample tray/sample probe : Level detection time is out of range (too early)		
02000b			Sample tray/sample probe : Level sensor triggered while reading down-limit		
4.2 List of errors					
020102			Sample tray/sample probe : S-format check-sum problem (while downloading S/W from Ma	H/W problem (ROM program was not copied correctly to RAM)	
020106			Sample tray/sample probe : MPU extra RAM access problem (during starting up)	H/W problem	
020107			Sample tray/sample probe : MPU RAM access problem (during starting up)	H/W problem	
020108			Sample tray/sample probe : OP code problem	S/W Problem	
020120			During reset cycle, sample probe cannot reach the top position	Problem with vertical movement of up/down unit	
020121			During reset cycle, sample probe cannot go down from the top position	Problem with vertical movement of up/down unit	
020122			During reset cycle, sample dispensor cannot find the orginal position		
020123			During reset cycle, sample probe cannot move from the inital position		
020124			During reset cycle, sample probe cannot find the pulse pattern set by dip SW	Dip SW is not set up yet	
020125			During reset cycle, sample syringe cannot reach the top position	Sensor problem	
020126			During reset cycle, sample syringe cannot move from the initial position		
020127			During reset cycle, Sample tray cannot find the orginal position		
020128			During reset cycle, Sample tray cannot move from the initial position		
020129			During reset cycle, Sample tray cannot stop at the correct position		
02012a			At cell position, sample probe cannot reach the top position		
02012b			At rinsing well, sample probe cannot reach the top position		
02012c			At detergent position, sample probe cannot reach the top position		
02012d			At outer sample position, sample probe cannot reach the top position		
02012e			At middle sample position, sample probe cannot reach the top position		
02012f			At inner sample position, sample probe cannot reach the top position		
020130			At cell position, sample probe cannot move from the top position		
020131			At rinsing well, sample probe cannot move from the top position		
020132			At detergent position, sample probe cannot move from the top position		
020133			At outer sample position, sample probe cannot move from the top position		
020134			At middle sample position, sample probe cannot move from the top position		

Error Code	Parameter1	Parameter2	Error description	Location of the problem	Note
020135			At inner sample position, sample probe cannot move from the top position		
020136			Probe shock sensor triggered (at cell position)		
020137			Probe shock sensor triggered (at rinsing pot position)		
020138			Probe shock sensor triggered (at detergent position)		
020139			Probe shock sensor triggered (at outer sample position)		
02013a			Probe shock sensor triggered (at middle sample position)		
02013b			Probe shock sensor triggered (at inner sample position)		
02013c			Probe cannot rotate to the position (at cell position)		
02013d			Probe cannot rotate to the position (at rinsing pot position)		
02013e			Probe cannot rotate to the position (at detegent position)		
02013f			Probe cannot rotate to the position (at outer sample position)		
020140			Probe cannot rotate to the position (at middle sample position)		
020141			Probe cannot rotate to the position (at inner sample position)		
020142			Sample syringe cannot reach the top position		
020143			Sample syringe cannot move from the top position		
020144			Sample tray cannot stop correctly (for outer sample)		
020145			Sample tray cannot stop correctly (for middle sample)		
020146			Sample tray cannot stop correctly (for inner sample)		
020147			During reset cycle, sample level sensor voltage not within 0.5 and 4.5 Volts range		
020148			Probe shock sensor triggered at up position		
020149			At sample dispensing time, Sample tray continues rotating		
02014a			Fuse broken : FS4(24V)		
02014b			Fuse broken : FS1(24V)		
02014c			When Sample tray starts rotating, ISE probe is still at down position		
02014d			Probe cannot rotate because it is not at the top position		
02014e			When Sample tray starts rotating, reagent 1 probe is still in the down position		
02014f			When Sample tray starts rotating, sample stirrer is still in the down position		
020150			When sample probe starts rotating, Reagent 1 probe is still at the dispensing position		
020151			When Sample tray starts rotating, sample probe does not reach the top position		
020180 - 020196			Sample tray/sample probe : time-out		
5. Reagent tray/reagent 1 dispenser					
5.1 List of warnings					
030001			Reagent tray/Reagent 1 probe : Target volume insufficient	Reagent is short	
030003			Reagent tray/Reagent 1 probe : received another command while waiting for "Reset" comn	S/W Problem	
030004			Reagent tray/Reagent 1 probe : Interrupt problem	S/W Problem	
030006			Reagent tray/Reagent 1 probe : Command problem	S/W Problem	
030007			Reagent tray/Reagent 1 probe : Parameter problem	S/W Problem	
030008			Reagent tray/Reagent 1 probe : Level sensor problem (level detection problem)		
030009			Reagent tray/Reagent 1 probe : Level sensor problem (liquid section problem)		
03000a			Reagent tray/Reagent 1 probe : Level detection time is out of range (too early)		
03000b			Reagent tray/Reagent 1 probe : Level sensor triggered while reading down-limit		
5.1 List of errors					
030102			Reagent tray/RGT 1 probe : S-format check-sum problem (while downloading S/W from Main CPU)		
030106			Reagent tray/Reagent 1 probe : MPU extra RAM access problem (during starting up)		
030107			Reagent tray/Reagent 1 probe : MPU RAM access problem (during starting up)		
030108			Reagent tray/Reagent 1 probe : OP code problem		

Error Code	Parameter1	Parameter2	Error description	Location of the problem	Note
030120			During reset cycle, Reagent 1 probe cannot reach the top position		
030121			During reset cycle, Reagent 1 probe cannot go down from the top position		
030122			During reset cycle, Reagent 1 probe cannot find the original position		
030123			During reset cycle, Reagent 1 probe cannot move from the initial position		
030124			During reset cycle, Reagent 1 probe cannot find the pulse pattern set by dip SW		
030125			During reset cycle, Reagent 1 syringe cannot reach the top position		
030126			During reset cycle, Reagent 1 syringe cannot move from the initial position		
030127			During reset cycle, Reagent tray cannot find the original position		
030128			During reset cycle, Reagent tray cannot move from the initial position		
030129			During reset cycle, Reagent tray cannot stop at the correct position		
03012a			Reagent 1 probe cannot reach the top position (at rinsing pot position)		
03012b			Reagent 1 probe cannot reach the top position (at detergent 1 position)		
03012c			Reagent 1 probe cannot reach the top position (at detergent 2 position)		
03012d			Reagent 1 probe cannot reach the top position (at Reagent tray outer position)		
03012e			Reagent 1 probe cannot reach the top position (at Reagent tray inner position)		
03012f			Reagent 1 probe cannot reach the top position (at Sample tray middle position)		
030130			Reagent 1 probe cannot move from the top position (at rinsing pot position)		
030131			Reagent 1 probe cannot move from the top position (at detergent 1 position)		
030132			Reagent 1 probe cannot move from the top position (at detergent 2 position)		
030133			Reagent 1 probe cannot move from the top position (at Reagent tray outer position)		
030134			Reagent 1 probe cannot move from the top position (at Reagent tray innrer position)		
030135			Reagent 1 probe cannot move from the top position (at Sample tray middle position)		
030136			Reagent 1 probe shock sensor triggered (at rinsing pot position)		
030137			Reagent 1 probe shock sensor triggered (at detergent 1 position)		
030138			Reagent 1 probe shock sensor triggered (at detergent 2 position)		
030139			Reagent 1 probe shock sensor triggered (at Reagent tray outer position)		
03013a			Reagent 1 probe shock sensor triggered (at Reagent tray inner position)		
03013b			Reagent 1 probe shock sensor triggered (at Sample tray middle position)		
03013c			Reagent 1 probe cannot rotate to the position (at cell position)		
03013d			Reagent 1 probe cannot rotate to the position (at incubator position)		
03013e			Reagent 1 probe cannot rotate to the position (at rinsing pot position)		
03013f			Reagent 1 probe cannot rotate to the position (at detergent 1 position)		
030140			Reagent 1 probe cannot rotate to the position (at detergent 2 position)		
030141			Reagent 1 probe cannot rotate to the position (at Reagent tray outer position)		
030142			Reagent 1 probe cannot rotate to the position (at Reagent tray inner position)		
030143			Reagent 1 probe cannot rotate to the position (at Sample tray middle position)		
030144			Reagent 1 syringe cannot reach the top position		
030145			Reagent 1 syringe cannot move from the top position		
030146			Reagent tray cannot stop correctly (for outer reagents)		
030147			Reagent tray cannot stop correctly (for inner reagents)		
030148			During reset cycle, reagent 1 level sensor voltage is not within 0.5 and 4.5 Volts range		
030149			Reagent 1 probe shock sensor triggered at up position		
03014a			At Reagent 1 dispensing time, Reaction disk continues rotating		
03014b			Fuse broken : FS8(24V)		
03014c			Fuse broken : FS2(24V)		
03014d			When Reagent tray starts rotating, reagent 2 probe is still at down position		

Error Code	Parameter1	Parameter2	Error description	Location of the problem	Note
03014e			Reagent 1 probe cannot rotate because it is not at the top position		
03014f			Reagent 1 probe cannot go down because Sample tray is still rotating		
030150			Sample probe is still at the cell position when Reagent 1 probe starts rotating,		
030151			When Reagent tray starts rotating, reagent 2 probe does not reach the top position		
030180 - 03018f			Reagent tray/Reagent 1 probe : time-out		
6. Reagent 2 dispenser/Sample cup stirrer					
6.1 List of warnings					
040001			Reagent 2 probe/Sample stirrer : Target volume insufficient		
040003			Reagent 2 probe/Sample stirrer : received another command while waiting for "Reset" command		
040004			Reagent 2 probe/Sample stirrer : Interrupt problem		
040006			Reagent 2 probe/Sample stirrer : Command problem		
040007			Reagent 2 probe/Sample stirrer : Parameter problem		
040008			Reagent 2 probe/Sample stirrer : Level sensor problem (level detection problem)		
040009			Reagent 2 probe/Sample stirrer : Level sensor problem (liquid section problem)		
04000a			Reagent 2 probe/Sample stirrer : Level detection time is out of range (too early)		
04000b			Reagent 2 probe/Sample stirrer : Level sensor triggered while reading down-limit		
4.2 List of errors					
040102			Reagent 2 probe/Sample stirrer : S-format check-sum problem (while downloading S/W from Main CPU)		
040106			Reagent 2 probe/Sample stirrer : MPU extra RAM access problem (during starting up)		
040107			Reagent 2 probe/Sample stirrer : MPU RAM access problem (during starting up)		
040108			Reagent 2 probe/Sample stirrer : OP code problem		
040120			During reset cycle, Reagent 2 probe cannot reach the top position		
040121			During reset cycle, Reagent 2 probe cannot go down from the top position		
040122			During reset cycle, Reagent 2 probe cannot find the original position		
040123			During reset cycle, Reagent 2 probe cannot move from the initial position		
040124			During reset cycle, Reagent 2 probe cannot find the pulse pattern set by dip SW		
040125			During reset cycle, Reagent 2 syringe cannot reach the top position		
040126			During reset cycle, Reagent 2 syringe cannot move from the initial position		
040127			During reset cycle, sample stirrer cannot reach the top position		
040128			During reset cycle, sample stirrer cannot move from the top position		
040129			During reset cycle, sample stirrer probe cannot move from the top position		
04012a			During reset cycle, sample stirrer probe cannot find the original position		
04012b			Reagent 2 probe cannot reach the top position (at detergent for incubator position)		
04012c			Reagent 2 probe cannot reach the top position (at rinsing pot position)		
04012d			Reagent 2 probe cannot reach the top position (at detergent 1 position)		
04012e			Reagent 2 probe cannot reach the top position (at detergent 2 position)		
04012f			Reagent 2 probe cannot reach the top position (at Reagent tray outer position)		
040130			Reagent 2 probe cannot reach the top position (at Reagent tray inner position)		
040131			Reagent 2 probe cannot move from the top position (at detergent for incubator position)		
040132			Reagent 2 probe cannot move from the top position (at rinsing pot position)		
040133			Reagent 2 probe cannot move from the top position (at detergent 1 position)		
040134			Reagent 2 probe cannot move from the top position (at detergent 2 position)		
040135			Reagent 2 probe cannot move from the top position (at Reagent tray outer position)		
040136			Reagent 2 probe cannot move from the top position (at Reagent tray inner position)		
040137			Reagent 2 probe shock sensor triggered (at detergent for incubator position)		
040138			Reagent 2 probe shock sensor triggered (at rinsing pot position)		

Error Code	Parameter1	Parameter2	Error description	Location of the problem	Note
040139			Reagent 2 probe shock sensor triggered (at detergent 1 position)		
04013a			Reagent 2 probe shock sensor triggered (at detergent 2 position)		
04013b			Reagent 2 probe shock sensor triggered (at Reagent tray outer position)		
04013c			Reagent 2 probe shock sensor triggered (at Reagent tray inner position)		
04013d			Reagent 2 probe cannot rotate correctly (at detergent for incubator position)		
04013e			Reagent 2 probe cannot rotate correctly (at cell position)		
04013f			Reagent 2 probe cannot rotate correctly (at incubator position)		
040140			Reagent 2 probe cannot rotate correctly (at rinsing pot position)		
040141			Reagent 2 probe cannot rotate correctly (at detergent 1 position)		
040142			Reagent 2 probe cannot rotate correctly (at detergent 2 position)		
040143			Reagent 2 probe cannot rotate correctly (at Reagent tray outer position)		
040144			Reagent 2 probe cannot rotate correctly (at Reagent tray inner position)		
040145			Reagent 2 syringe cannot reach the top position		
040146			Reagent 2 syringe cannot move from the top position		
040147			Sample stirrer cannot reach the top position (at rinsing pot position)		
040148			Sample stirrer cannot reach the top position (at detergent position)		
040149			Sample stirrer cannot reach the top position (at Sample tray outer position)		
04014a			Sample stirrer cannot reach the top position (at Sample tray inner position)		
04014b			Sample stirrer cannot move from the top position (at rinsing pot position)		
04014c			Sample stirrer cannot move from the top position (at detergent position)		
04014d			Sample stirrer cannot move from the top position (at Sample tray outer position)		
04014e			Sample stirrer cannot move from the top position (at Sample tray inner position)		
04014f			Sample stirrer cannot rotate correctly (at rinsing pot position)		
040150			Sample stirrer cannot rotate correctly (at detergent position)		
040151			Sample stirrer cannot rotate correctly (at Sample tray outer position)		
040152			Sample stirrer cannot rotate correctly (at Sample tray inner position)		
040153			During reset cycle, reagent 2 level sensor voltage is not within 0.5 and 4.5 Volts range		
040154			Reagent 2 probe shock sensor triggered at up position		
040155			At Reagent 2 dispensing time, reaction disk continues rotating		
040156			Fuse broken : FS9(24V)		
040157			Fuse broken : FS3(24V)		
040158			Reagent 2 probe cannot go down because Reagent tray continues rotating		
040159			Reagent 2 probe cannot rotate because it is not at the top position		
04015a			Sample stirrer cannot go down because Sample tray is still rotating		
040180 - 04018f			Reagent 2 probe/Sample stirrer : time-out		
7.1 List of warnings					
050001			Stirrer/Rinsing : Target volume insufficient		
050003			Stirrer/Rinsing : received another command while waiting for "Reset" command		
050004			Stirrer/Rinsing : Interrupt problem		
050006			Stirrer/Rinsing : Command problem		
050007			Stirrer/Rinsing : Parameter problem		
050008			Stirrer/Rinsing : Level sensor problem (level detection problem)		
050009			Stirrer/Rinsing : Level sensor problem (liquid section problem)		
05000a			Stirrer/rinsing : Level detection time is out of range (too early)		
05000b			Stirrer/Rinsing : Level sensor triggered while reading down-limit		
7.2 List of errors					

Error Code	Parameter1	Parameter2	Error description	Location of the problem	Note
050102			Stirrer/Rinsing : S-format check-sum problem (while downloading S/W from Main CPU)		
050106			Stirrer/Rinsing : MPU extra RAM access problem (during starting up)		
050107			Stirrer/Rinsing : MPU RAM access problem (during starting up)		
050108			Stirrer/Rinsing : OP code problem		
050124			During reset cycle, stirrer cannot reach the top position		
050125			During reset cycle, stirrer cannot move from the top position		
050126			During reset cycle, sensor continues to be inactive (light off)		
050127			During reset cycle, sensor continues to be active (light passed)		
050128			During reset cycle, pulse pattern problem		
050129			Passive sensor continues to be active (light passed)		
05012a			After reset process, low position sensor is still inactive (light off)		
05012c			During reset cycle, cuvette wash station assembly cannot go down		
05012d			During reset cycle, cuvette wash station assembly cannot go up		
05012e			cuvette wash station assembly cannot go down		
05012f			cuvette wash station assembly cannot go up		
050130			cuvette wash station assembly cannot find stirring position 1		
050131			cuvette wash station assembly cannot find stirring position 1/2		
050132			Stirrer cannot go up		
050133			Stirrer cannot go down		
050134			Stirrer rotation start position problem (at rinsing pot position)		
050135			Stirrer rotation start position problem (at stirring position 1)		
050136			Stirrer rotation start postion problem (at stirring position 1/2)		
050137			Stirrer cannot go down because reaction disk is rotating		
050138			cuvette wash station assembly cannot go down because reaction disk is rotating		
050139			Stirrer cannot go down because it is not at top position		
050155			cuvette wash station assembly cannot go down because it is not at top position		
050156			cuvette wash station assembly cannot go down because it is already detected at low position		
050157			cuvette wash station assembly cannot go up because it is already detected at top position		
050158			cuvette wash station assembly cannot go up because it is already at low position		
050159			cuvette wash station assembly cannot go up from halfway because it is detected at top position		
05015a			cuvette wash station assembly cannot go up from halfway because it is detected at low position		
05015c			Fuse broken : FS7(24V)		
05015d			Fuse broken : FS10(24V)		
050180 - 0501d6			Stirrer/Rinsing : time-out		
8. Cuvette stirrer/cuvette rinse					
8.1 List of errors					
090101			ISE RS232C data error : character after ESC is not 07H nor 0BH		
090102			ISE RS232C data error : number of data is less than 3		
090103			ISE RS232C data error : BCC error		
090104			ISE RS232C data error : overrun error		
090105			ISE RS232C data error : framing error		
090107			ISE A/D conversion time over : Na		
090108			ISE A/D conversion time over : K		
090109			ISE A/D conversion time over : Cl		
09010a			ISE A/D conversion time over : REF		
09010b			ISE A/D conversion time over : reagent 1 sensor		

Error Code	Parameter1	Parameter2	Error description	Location of the problem	Note
09010c			ISE A/D conversion time over : reagent 2 sensor		
09010d			ISE A/D conversion time over : reagent 3 sensor		
09010e			ISE A/D conversion time over : reagent 4 sensor		
09010f			ISE A/D conversion time over : GND		
090110			ISE A/D over range (>full scale +5%) : Na		
090111			ISE A/D over range (>full scale +5%) : K		
090112			ISE A/D over range (>full scale +5%) : Cl		
090113			ISE A/D over range (>full scale +5%) : REF		
090114			ISE A/D over range (>full scale +5%) : reagent 1 sensor		
090115			ISE A/D over range (>full scale +5%) : reagent 2 sensor		
090116			ISE A/D over range (>full scale +5%) : reagent 3 sensor		
090117			ISE A/D over range (>full scale +5%) : reagent 4 sensor		
090118			ISE A/D over range (>full scale +5%) : GND		
09011f			ISE probe error : during rotation, top position sensor became active(open)		
090120			ISE probe rotation error : During reset cycle, horizontal position sensor continued active more than 40 pulses		
090121			ISE probe rotation error : During reset cycle, backrush is more than 5 pulses		
090122			ISE probe rotation error : During reset cycle, horizontal position sensor continued inactive(close) more than 328 pulses		
090123			ISE probe rotation error : During reset cycle, more than 8 sectors were detected		
090124			ISE probe rotation error : horizontal sensor became active on the way from slope position to injection pot		
090125			ISE probe rotation error : horizontal sensor in inactive (at injection pot from slope position)		
090126			ISE probe rotation error : horizontal sensor became active on the way from injection pot to waste position		
090127			ISE probe rotation error : horizontal sensor is inactive (at drain position from injection pot)		
090128			ISE probe rotation error : horizontal sensor became active on the way from waste position to rinse pot position		
090129			ISE probe rotation error : horizontal sensor is inactive (at rinse pot from waste position)		
09012a			ISE probe rotation error : horizontal sensor became active on the way from rinse pot to pure water position		
09012b			ISE probe rotation error : horizontal sensor is inactive (at pure water position from rinse pot)		
09012c			ISE probe rotation error : horizontal sensor became active on the way from pure water position to Sample tray inner position		
09012d			ISE probe rotation error : horizontal sensor is inactive (at Sample tray inner position from pure water position)		
09012e			ISE probe rotation error : horizontal sensor became active on the way from Sample tray inner to mid position		
09012f			ISE probe rotation error : horizontal sensor is inactive (at Sample tray mid position from Sample tray inner position)		
090130			ISE probe rotation error : horizontal sensor became active on the way from Sample tray mid to outer position		
090131			ISE probe rotation error : horizontal sensor in inactive (at Sample tray outer position from Sample tray mid position)		
090132			ISE probe rotation error : horizontal sensor became active on the way from Sample tray outer to mid position		
090133			ISE probe rotation error : horizontal sensor is inactive (at Sample tray mid position from Sample tray outer position)		
090134			ISE probe rotation error : horizontal sensor became active on the way from Sample tray mid to inner position		
090135			ISE probe rotation error : horizontal sensor is inactive (at Sample tray inner position from Sample tray mid position)		
090136			ISE probe rotation error : horizontal sensor became active on the way from Sample tray inner position to pure water position		
090137			ISE probe rotation error : horizontal sensor is inactive (at pure water position from Sample tray inner position)		
090138			ISE probe rotation error : horizontal sensor became active on the way from pure water position to rinse pot		
090139			ISE probe rotation error : horizontal sensor is inactive (at rinse pot from pure water position)		
09013a			ISE probe rotation error : horizontal sensor became active on the way from rinse pot to waste position)		
09013b			ISE probe rotation error : horizontal sensor is inactive (at waste position from rinse pot)		
09013c			ISE probe rotation error : horizontal sensor became active on the way from waste position to injection pot		
09013d			ISE probe rotation error : horizontal sensor is inactive (at injection pot from waste position)		
09013e			ISE probe rotation error : horizontal sensor became active on the way from injection pot to slope pot		
09013f			ISE probe rotation error : horizontal sensor is inactive (at slope pot from injection pot)		

Error Code	Parameter1	Parameter2	Error description	Location of the problem	Note
090140			ISE probe up/down error : During reset cycle, top position sensor continued active more than 1640 pulses		
090141			ISE probe up/down error : During reset cycle, top position sensor continued inactive more than 80 pulses		
090142			ISE probe up/down error : During reset cycle, backrush exceeds more than 20 pulses		
090143			ISE probe up/down error : horizontal sensor became inactive during up/down		
090144			ISE probe up error : top sensor became inactive incorrectly at slope pot		
090145			ISE probe up error : probe cannot reach the top position at slope pot (< +-1mm)		
090146			ISE probe up error : top sensor became active incorrectly at slope pot		
090147			ISE probe down error : top sensor became active incorrectly at slope pot		
090148			ISE probe down error : top sensor became inactive incorrectly at slope pot		
090149			ISE probe up error : top sensor became inactive incorrectly at injection pot		
09014a			ISE probe up error : probe cannot reach the top position at injection pot		
09014b			ISE probe up error : top sensor became active incorrectly at injection pot		
09014c			ISE probe down error : top sensor became active incorrectly at injection pot		
09014d			ISE probe down error : top sensor became inactive incorrectly at injection pot		
09014e			ISE probe up error : top sensor became inactive incorrectly at waste position		
09014f			ISE probe up error : probe cannot reach the top position at waste position		
090150			ISE probe up error : top sensor became active incorrectly at waste position		
090151			ISE probe down error : top sensor became active incorrectly at waste position		
090152			ISE probe down error : top sensor became inactive incorrectly at waste position		
090153			ISE probe up error : top sensor became inactive incorrectly at rinse pot		
090154			ISE probe up error : probe cannot reach the top position at rinse pot		
090155			ISE probe up error : top sensor became active incorrectly at rinse pot		
090156			ISE probe down error : top sensor became active incorrectly at rinse pot		
090157			ISE probe down error : top sensor became inactive incorrectly at rinse pot		
090158			ISE probe up error : top sensor became inactive incorrectly at pure water position		
090159			ISE probe up error : probe cannot reach the top position at pure water position		
09015a			ISE probe up error : top sensor became active incorrectly at pure water position		
09015b			ISE probe down error : top sensor became active incorrectly at pure water position		
09015c			ISE probe down error : top sensor became inactive incorrectly at pure water position		
09015d			ISE probe up error : top sensor became inactive incorrectly at Sample tray inner position		
09015e			ISE probe up error : probe cannot reach the top position at Sample tray inner position		
09015f			ISE probe up error : top sensor became active incorrectly at Sample tray inner position		
090160			ISE probe down error : top sensor became active incorrectly at Sample tray inner position		
090161			ISE probe down error : top sensor became inactive incorrectly at Sample tray inner position		
090162			ISE probe up error : top sensor became inactive incorrectly at Sample tray middle position		
090163			ISE probe up error : probe cannot reach the top position at Sample tray middle position		
090164			ISE probe up error : top sensor became active incorrectly at Sample tray middle position		
090165			ISE probe down error : top sensor became active incorrectly at Sample tray middle position		
090166			ISE probe down error : top sensor became inactive incorrectly at Sample tray middle position		
090167			ISE probe up error : top sensor became inactive incorrectly at Sample tray outer position		
090168			ISE probe up error : probe cannot reach the top position at Sample tray outer position		
090169			ISE probe up error : top sensor became active incorrectly at Sample tray outer position		
09016a			ISE probe down error : top sensor became active incorrectly at Sample tray outer position		
09016b			ISE probe down error : top sensor became inactive incorrectly at Sample tray outer position		
09016c			ISE probe shock sensor triggered		
09016d			ISE probe cannot detect low dead end position		

Error Code	Parameter1	Parameter2	Error description	Location of the problem	Note
090170			ISE triple syringe pump error : During reset cycle, syringe cannot reach the top position within 3600 pulses		
090171			ISE triple syringe pump error : During reset cycle, top position sensor continued inactive more than 500 pulses		
090172			ISE triple syringe pump error : During reset cycle, backrush exceeded 100 pulses		
090173			ISE triple syringe pump up error : top sensor became inactive incorrectly		
090174			ISE triple syringe pump up error : syringe cannot reach the top position (< +-1mm)		
090175			ISE triple syringe pump up error : top sensor became active incorrectly		
090176			ISE triple syringe pump down error : top sensor became active incorrectly		
090177			ISE triple syringe pump down error : top sensor became inactive incorrectly		
090180			ISE cal syringe pump error : During reset cycle, syringe cannot reach the top position within 2156 pulses		
090181			ISE cal syringe pump error : During reset cycle, top position sensor continued inactive more than 395 pulses		
090182			ISE cal syringe pump error : During reset cycle, backrush exceeded 60 pulses		
090183			ISE cal syringe pump up error : top sensor became inactive incorrectly		
090184			ISE cal syringe pump up error : syringe cannot reach the top position (< +-1mm)		
090185			ISE cal syringe pump up error : top sensor became active incorrectly		
090186			ISE cal syringe pump down error : top sensor became active incorrectly		
090187			ISE cal syringe pump down error : top sensor became inactive incorrectly		
090190			ISE time-out error : probe waited for sampling ready more than 3 seconds		
0901c0			ISE shock sensor triggered at sampling : Sample volume insufficient		
9. Other errors					
0a0001			Some cells are unavailable because of "Water Blank Error"		
0a0101			PC :Failure sending worklist		
0a0102			PC : command to start analyzing was not accepted		
0a0103			PC : Failure sending parameters		
0a0160			PC : next command-transfer		

9 Parts (note: section obsolete)

9.1 Spare parts list

No	IL P/N	Shimadzu P/N	Description
1	18470000	0322247220	Belt,B100-S3M-225:
2	18470010	0356156431	Hose Nipple,VFM6106:
3	18470020	0356156432	Hose Nipple,VFM6206:
4	18470030	0426093512	Medium,FL8 (fan filter):
5	18470040	0720166500	Fuse,3266.25:
6	18470050	0720166528	Fuse,32603.2:
7	18470060	0720166531	Fuse,3266.25:
8	18470070	0720166534	Fuse,326010:
9	18470080	0720166536	Fuse,326 015:
10	18470090	0720200511	Fuse,2391.25:
11	18470100	0720201012	Fuse,237008:
12	18470110	0720564802	Fuse,OGN 0031-8201:
13	18470120	0748038201	Power,LWT-30H-522:
14	18470130	0748067812	Power,LDC15F-1:
15	18470140	0777990201	Dumper,FD035AS:
16	18470150	2046243503	Filter (10x10):
17	18470160	2046401623	Teflon tube Flare:
18	18470170	2064106206	Planger Assy,P:
19	18470180	2064106207	Planger Assy,R:
20	18470190	2064121600	Stirring rod Assy:
21	18470200	2064319200	Rapping tape:
22	18470210	2064320800	Thermistor Assy:
23	18470220	2064572702	Seal,Probe:
24	18470230	2064702400	Liquid Sensor Assy:

25	18470240	2064856001	Syringe Pump Assy
26	18470250	2064856002	Syringe Pump Assy
27	18470260	2410102500	Analyzing Unit Assy
28	18470270	2410115500	Tray Assy,Detergent
29	18470280	2410120000	Sampler Assy
30	18470290	2410120300	Moter Assy,Sample:
31	18470300	2410120900	Sensor Assy,Sample tray
32	18470310	2410124001	Sample tray
33	18470320	2410127500	Reagent Container Assy
34	18470330	2410127900	Fan Assy,Reagent Container
35	18470340	2410134000	Reagent tray
36	18470350	2410140000	Reaction Assy
37	18470360	2410140500	Moter Assy,Photometer:
38	18470370	2410141600	Photometer Assy:
39	18470380	2410146300	Liquid Sensor:
40	18470390	2410147000	Amplifier Unit Assy
41	18470400	2410152500	Reaction Bath Assy:
42	18470410	2410155000	Reaction Disk Assy:
43	18470420	2410155200	Holder Assy:
44	18470430	2410155500	Disk:
45	18470440	2410160000	Sample Dispenser Assy
46	18470450	2410160100	Reagent Dispenser 1 Assy
47	18470460	2410160200	Reagent Dispenser 2 Assy
48	18470470	2410161900	Pot Assy,Sample
49	18470480	2410162000	Pot Assy,RGT
50	18470490	2410165000	Sample probe Assy:
51	18470500	2410165100	Reagent probe Assy:
52	18470510	2410170000	Stirrer Assy
53	18470520	2410172100	Pot Assy,STR1
54	18470530	2410172200	Pot Assy,STR2
55	18470540	2410172300	Moter Assy,STR:
56	18470550	2410174500	Moter Assy 1:
57	18470560	2410174600	Moter Assy 2:
58	18470570	2410177900	Manifold Assy
59	18470580	2410180000	Tank Unit Assy
60	18470590	2410180500	Tank Assy

61	18470600	2410180600	Float-Switch Assy:
62	18470610	2410182500	Valve Assy,Pure Water
63	18470620	2410182900	Detergent Dilution Assy
64	18470630	2410183700	Poat Assy
65	18470640	2410183801	Tube Assy,Dilute:
66	18470650	2410183802	Tube Assy,Dilute:
67	18470660	2410184500	Pump Assy,Pure Water:
68	18470670	2410185600	Valve Assy,In & Out
69	18470680	2410186000	Degasser Unit Assy
70	18470690	2410186800	Switch Assy:
71	18470700	2410190000	Reservoir Assy
72	18470710	2410191100	Duct(A),Assy
73	18470720	2410191900	SA Reserver:
74	18470730	2410192000	Heater Assy:
75	18470740	2410195000	Drain Pot Assy
76	18470750	2410197400	Tank Unit Assy,Vacuum
77	18470760	2410197700	Level Sensor Assy:
78	18470770	2410198700	Vacuum Pump Assy:
79	18470780	2410207500	Rinse Assy
80	18470790	2410208100	Probe,Rinse Assy:
81	18470800	2410208700	Probe,Dry Assy:
82	18470810	2410209200	Drying tip:
83	18470820	2410280000	AC Power Box Assy
84	18470830	2410281000	Timer Box Assy
85	18470840	2410282000	SW Regulator
86	18470850	2410284000	Panel Assy,Interface
87	18470860	2410286000	DC Power Box Assy
88	18470870	2410290000	PCB Assy,AMP
89	18470880	2410290300	PCB Assy,photosensor:
90	18470890	2410290600	PCB Assy,SensorLQ
91	18470900	2410290900	PCB Assy,Conector Nozzel:
92	18470910	2410291200	PCB Assy,Conector Strrer:
93	18470920	2410291500	PCB Assy,Conector Pump:
94	18470940	2410291800	PCB Assy,Nozzle Sensor 2R
95	18470950	2410297400	Thermistor Assy:
96	18470960	2410297500	PCB Assy,DC Power

97	18470970	2410297800	PCB Assy,TEMP Cont.
98	18470980	2410298100	PCB Assy,SSR:
99	18470990	2410298400	PCB Assy,DC Branch
100	18471000	2410298700	PCB Assy,Panel I/F:
101	18471010	2410299500	PCB Assy,Timer
102	18471020	2410300000	Controller Assy
103	18471030	2410302500	PCB Assy,CPU Mother
104	18471040	2410302800	PCB Assy,CPU Main
105	18471050	2410303100	PCB Assy,CPU Slave A
106	18471060	2410303400	PCB Assy,CPU Slave B
107	18471070	2410305000	PCB Assy,Driver Mother
108	18471080	2410305300	PCB Assy,I/O Driver A
109	18471090	2410305600	PCB Assy,I/O Driver B
110	18471100	2410311000	Terminal Assy:
111	18471110	2410403100	Mixer Assy:
112	18471120	2410409200	Plunger Assy,SUS316:
113	18471130	2410415200	Probe Assy, ISE:
114	18471140	2410427500	PCB Assy,ISE MAIN:
115	18471150	2410427800	PCB Assy,ISE Preamp:
116	18471160	2410428200	PCB Assy,Reagent Sensor 2
117	18471170	2410428600	PCB Assy,Reagent Sensor 1
118	18471180	2410429000	PCB Assy,ISE Nozzle:
119	18471190	2410429300	PCB Assy,Shock Sensor:
120	18471200	2419002302	Tube Poaron,1.0x3.0:
121	18471210	2419002303	Tube Poaron,1.5x3.0:
122	18471220	2419002306	Tube Poaron,2.0x4.0:
123	18471230	2419352202	Valve,Glove A100,3/8:
124	18471240	2419352801	Valve,MCV-2V-M5FS:
125	18471250	2419353100	Degassed Module:
126	18471260	2419353204	Valve,USG2:
127	18471270	2419353300	Fan,D12C4H-25:
128	18471280	2419353400	Degassed Tank,CB74-410:
129	18471290	2419353500	Fan,109P1224H415:
130	18471300	2419354100	Valve,LFVA2430113H:
131	18471310	2419355000	Valve,C0260-86AT:
132	18471320	2419355100	Valve,C240-86AT:

133	18471330	2419355300	Thermo-cooler,OCE-30PX2:
134	18471340	2419402700	Cuvette Cell:
135	18471350	2419501000	Lamp,PG-64258/ME-MLP:

10 Maintenance

10.1 Maintenance schedule

This section contains all the information and procedures required for performing the service preventive maintenance.

In order to maintain the ILab600 system in optimal conditions two service preventive maintenance visits per year are suggested.

Actions to be performed during the PM visit are indicated in table below:

Preventive Maintenance Summary
1. Cleaning Actions
1.1 Clean the external surface of stirrers, R1 &R2, sample and ISE probes
1.2 Clean internal surface of reagent probes, sample probe.
1.3 Clean rinse wells of stirrers, reagent probes, sample probe
1.4 Clean Cuvettes
1.5 Clean Incubator
1.6 Clean Cuvettes Cover
1.7 Clean Incubator level sensor
1.8 Clean Fan filters
1.9 Clean syringe and syringe manifold filters
1.10 Clean syringe plungers
1.11 Clean on-board cuvette detergent filters
1.12 Clean arm shaft of stirrers, sample and reagent probes, and lubricate
1.13 Clean water inlet filter
1.14 Clean ISE syringe plungers to remove salt deposits.
1.15 Clean ISE sample dilution pot to remove salt deposits.
1.17 Clean ISE sample fluidics

1.18 Clean waste tank level sensor
1.19 Clean window of Bar Code Reader
2. Replacement Actions
2.1 Replace sample and reagent 1 & 2 syringe seals
2.2 Replace High calibrator pot seal
2.3 Replace ISE syringe seal for: ISE Diluent, ISE Reference, ISE Calibrator and ISE Sample syringes
2.4 Replace ISE probe seal
2.5 Replace ISE tubings (the following 2 tubings):
a: tubing from dilution pot to mixer 1
b: tubing from mixer 1 to mixer 2
3. Checkouts, Alignments and Adjustments Actions
3.1 Check quality of deionized water supply.
3.2 Check water level in cuvettes during washing, adjust if required
3.3 Check water pressure, adjust if required
3.4 Check sample probe for damage, replace if necessary
3.5 Check the alignment of sample probe, reagent probes, stirrers, cuvette wash probes and ISE probe
3.6 Set the Bottom Limit of the Sample Probe
3.7 Set the Bottom limit of the Reagent Probe
3.8 Check the photometer lamp, replace if necessary
3.9 Check electrodes, replace if necessary
3.10 Check cuvette drying tip, replace if necessary (it should be replaced one time/ year)
3.11 Check tubings of Cuvette Washing station, replace if necessary
4. Analytical Verifications
4.1 Run water blank. check results and reset Base Water Blank
4.2 Run ISE internal calibration
4.3 Run a precision test selecting indicatively 3-4 chemistries + ISE
4.4 Run some QC sample and verify the accuracy of the system
4.5 Verify the accuracy of the QC data stored in the ILab system

10.2 Cleaning solutions

Cleaning solution to be used during Preventive Maintenance are listed in table below; the concentration to be used is indicated at each specific Preventive Maintenance procedure.

Cleaning solution	Catalog Number
Alkaline Detergent	182537-10
Acid Detergent	182538-00
Bath Additive	184694-00
Cuvette Alkaline Detergent	184690-00
Cuvette Acid Detergent	184691-00
ISE Activator	182540-00

10.3 Maintenance procedures

NOTE: THE PROCEDURES REPORTED IN THIS SECTION ARE SOMETIMES MISSING OF THE RELEVANT FIGURE.

PLEASE REFER TO THE PROCEDURE REPORTED IN THE ILab600 OPERATOR'S MANUAL, THAT INCLUDES THE SAME PROCEDURE, INCLUDING THE FIGURES.

10.2 Cleaning solutions

Cleaning solution to be used during Preventive Maintenance are listed in table below; the concentration to be used is indicated at each specific Preventive Maintenance procedure.

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Alkaline Detergent	182537-10
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Bath Additive	184694-00
Cuvette Alkaline Detergent	184690-00
Cuvette Acid Detergent	184691-00
ISE Activator	182540-00

10.3 Maintenance procedures

10.3.1 Clean Surface of Probes and Stirrers

Cleaning External Surface of Stirrers

1. Open the H/W Maintenance menu and click on Stirrer to open the Stirrer screen.
2. In the Replace frame at the bottom of the screen, click on Move for Replacement. This will free the rotational tension on the arm, and allow the operator to rotate the arm by hand to move it to a comfortable working position.
3. Wipe the stirrer paddle surface clean with a soft gauze or cotton swab soaked in a 2% Alkaline Detergent solution, rinse with gauze or cotton soaked in deionized water.

Note: improper or incomplete cleaning may result in cross-contamination.

4. Click on Replacement Canceled to return the stirring paddle to the rinse cup position in the standby state.

Note: do NOT click on Replacement Complete since this will cause an update of the paddle replacement record.

5. Close the Stirrer screen and H/W Maintenance menu.

Note: closing the H/W Maintenance menu resets the entire analyzing module.

Cleaning External Surface of Reagent Probes

1. Open the H/W Maintenance menu and click on R1 Probe or

R2 Probe to open the Reagent R1 or R2 screen.

2. In the Replace frame at the bottom of the screen, click on Move for Replacement. This will free the rotational tension on the arm, and allow the operator to rotate the arm by hand to move it to a comfortable working position over the reagent tray.
3. Wipe the probe surface clean with a soft gauze or cotton swab soaked in a 2% Alkaline Detergent solution, rinse with gauze or cotton soaked in deionized water. If the probe cannot be properly cleaned, repeat the procedure using a 2% Acid Detergent solution.

Note: incomplete or improper cleaning may result in cross-contamination.

4. Click on Replacement Canceled to return the probe to the rinse cup position in the standby state.

Note: do NOT click on Replacement Complete since this will cause an update of the reagent probe replacement record.

5. Close the R1 Probe or R2 Probe screen and H/W Maintenance menu.

Note: closing the H/W Maintenance menu resets the entire analyzing module.

Cleaning External Surface of Sample Probe

While performing this work, wear gloves and protective goggles to prevent contamination with biohazardous materials.

1. Open the H/W Maintenance menu and click on Sample Probe to open the Sample Probe screen.
2. In the Replace frame at the bottom of the screen, click on Move for Replacement. This will free the rotational tension on the arm and allow the operator to rotate the arm by hand to move it to a comfortable working position over the sample tray.
3. Wipe the sample probe surface clean with a soft gauze or cotton swab soaked in a 2% Alkaline Detergent solution, rinse with gauze or cotton soaked in deionized water.

Note: improper or incomplete cleaning may result in carryover between samples and sampling inaccuracy.

5. Click on Replacement Canceled to return the sample probe to the rinse cup position in the standby state.

Note: do NOT Click on Replacement Complete since this will cause an update of the sample probe replacement record.

6. Close the Sample screen and H/W Maintenance menu.

Note: closing the H/W Maintenance menu resets the entire analyzing module.

Cleaning External Surface of ISE Probe

1. Open the ISE Maintenance menu and click on Probe to open the ISE Probe screen.
2. In the Replace frame at the bottom of the screen, click on Move for Replacement. This will free the rotational tension on the arm and allow the operator to rotate the arm by hand to move it to a comfortable working position
3. Wipe the ISE sample probe surface clean with a soft gauze or cotton swab soaked in a 2% Alkaline Detergent solution, rinse with gauze or cotton soaked in deionized water.

Note: improper or incomplete cleaning may result in cross-contamination.

4. Click on Replacement Canceled to return the sample probe to the rinse cup position in the standby state.

Note: do NOT Click on Replacement Complete since this will cause an update of the sample probe replacement record.

5. Close the Sample screen and ISE Maintenance menu.

Note: closing the H/W Maintenance menu resets the entire analyzing module.

10.3.2 Clean Internal Surface of Probes

The cleaning process for any of the probes involves the following steps:

1. Removing the probe.
2. Cleaning the probe. See procedure below
3. Reinstalling the probe.
4. Checking the probe's liquid level sensor. For this procedure refer to Section 3.2.2.4
5. Check the alignment of the probe.

Cleaning Internal Surface of Reagent Probe

When a reagent probe is used for an extended period, a buildup of material will form in spite of the daily detergent rinsing. This buildup may increase carryover between reagents and affect dispensing accuracy. Perform the detergent rinse procedure at least once a month as shown below, or at the frequency required by the system workload.

1. Use the 2% Alkaline Detergent solution.
2. Remove probe
3. Install a syringe on the tubing side of the probe and aspirate detergent through the probe (refer to Figure 10.1). Immerse only the probe tip in the detergent (avoid immersing the probe body). If the detergent has reached the probe body,

wash it off with water and dry it carefully.

4. Allow detergent to remain inside the probe for about 30 minutes, renewing the detergent three or four times during that period by repeating the aspirating operation.
5. Replace the detergent with water and rinse by repeated aspiration and discharging. Rinse the probe with water to remove all traces of detergent.
6. If stubborn deposits remain, especially when carry-over is suspected, repeat the rinsing as shown in steps 3. to 5., using the acid detergent.
7. Install the probe and perform an automated probe rinse through the Startup screen.

Figure 10.1 - probe internal cleaning

Cleaning Internal Surface of Sample Probe

When the sample probe is used for an extended period, a buildup of material will form in spite of the daily detergent rinsing. This buildup may increase carry-over between samples and affect dispensing accuracy. Perform the detergent rinse procedure at least once a month as shown below, or as often as required by the system workload.

1. Use the 2% Alkaline Detergent solution.
2. Remove probe
3. Install a syringe on the tubing side of the probe and aspirate detergent solution through the probe (refer to Figure 10.1). Immerse only the probe tip in the detergent (avoid immersing the probe body) and aspirate detergent through the probe. If detergent reaches the probe body, wash it of with water and dry it carefully.
4. Allow detergent to stand inside the probe for about 30 minutes, renewing the detergent three or four times during

that period by repeating the aspiration operation.

5. Replace the detergent with water and rinse by repeated aspiration and discharging. Rinse the probe with water to remove all traces of detergent.
6. Install the probe and perform an automated probe rinse through the Startup screen.

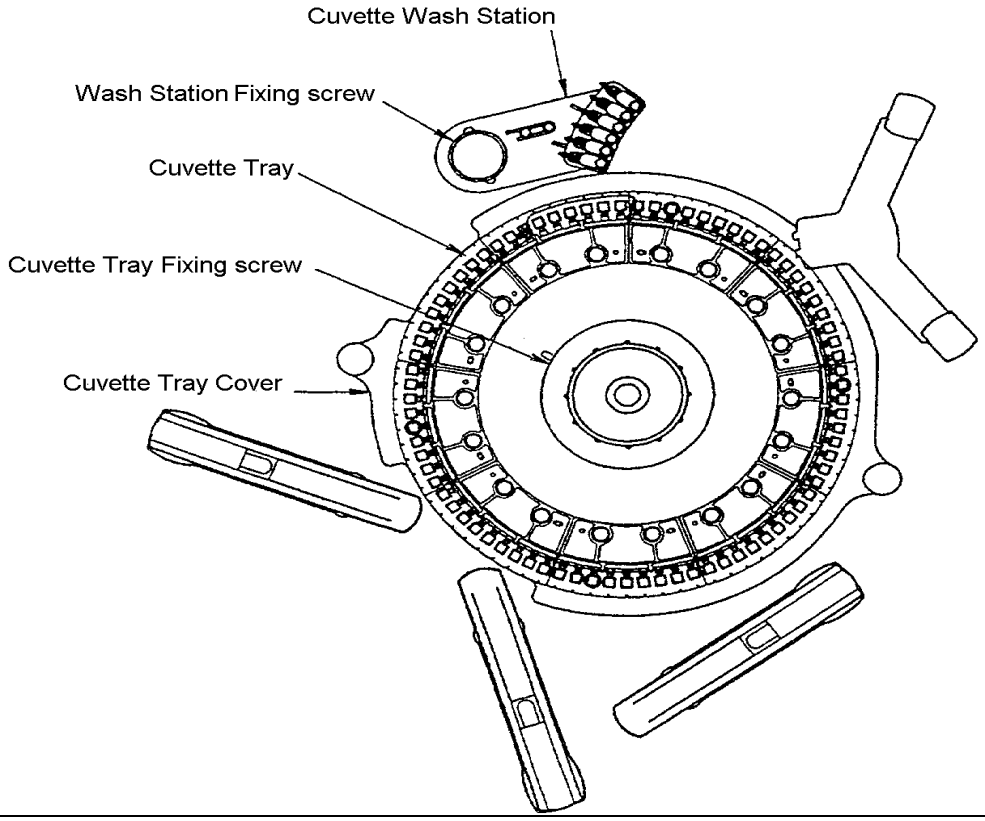
10.3.3 Clean the rinse wells

Although the rinse wells are cleaned to some extent during probe rinse in the Startup and Shutdown procedures, the periphery of the rinsing wells will need cleaning after a period of time. The wells should be cleaned with cotton swabs moistened with 2% Alkaline Detergent followed by water.

10.3.4 Clean the cuvettes

Once a month or whenever necessary, perform a visual inspection of the cuvettes for damage and proceed to clean them by following the steps below. Refer to the diagram in Figure 10.2 for the location of the parts to be handled during this procedure.

Figure 10.2 - Cuvette tray location



1. Open H/W Maintenance and select Water.
2. Click on Drain Water Bath. This drains the water bath, allowing the removal of the cuvette ring without spilling water into the analyzer.
3. Loosen the screw which fixes the cuvette wash station. Slightly lift and rotate the rinse probes to remove them from their position over the cuvettes. Remove the cuvette cover.
4. Loosen the cuvette ring fixing screw and remove the cuvette ring.

Note: be extremely careful not to spill water on the photometer side.

5. Immerse the cuvettes in a container filled with 2% Alkaline Detergent solution for about one hour, then rub the inside of each cuvette with a cotton swab moistened with detergent. If the outside of the cuvettes is dirty, carefully clean the optical path area with cotton swabs moistened with detergent (Figure 10.3).

Note: do not clean cuvettes in an ultrasonic bath, since this may deform the cuvettes.

6. Thoroughly rinse the cuvette assembly with distilled water and carefully wipe dry the cuvette tray. Make sure to wipe all water off the timing fence behind the cuvettes around the perimeter of the cuvette ring. This area is important for the timing during the photometric measurements.

Figure 10.3 - Cuvette cleaning

7. Place the cuvette ring back into place. Make sure the positioning pin of the cuvette ring is properly aligned with the positioning hole. Hand-tighten the cuvette ring fixing screw.

8. Install the cuvette cover on the tray and put the cuvette wash station back into place.

9. Close the H/W Maintenance screen. The incubator is refilled automatically and the Bath Additive is dispensed into the incubator.

Note: closing the H/W Maintenance menu resets the entire analyzing module.

10.3.5 Clean the Incubator

If the incubator water is contaminated, the suspended particles will affect the photometric measurements. Therefore keeping the incubator clean is of key importance to the quality of the test results. This procedure should be performed while the cuvettes are being cleaned. Refer to the diagram on Figure 10.4.

Figure 10.4 - Incubator cleaning

1. Drain the incubator and remove the cuvette ring.
2. Wipe-off deposits inside the incubator and on the photometric window with a lint-free cloth moistened with 2% detergent. Rinse the incubator with a lint-free cloth moistened with distilled water. Carefully avoid scratching the photometric window. Remove the partition of the overflow unit by pulling it up and clean the partition and overflow unit as well.
3. Remove the filter by lifting out the O-ring, and remove all particles from the filter with the aid of tweezers. A clogged

filter will impair circulation and affect temperature uniformity.

4. When work is completed, reinstall the parts which have been removed, including the cuvette ring. Cuvettes must be cleaned as indicated in Section 10.3.4.
5. Close the H/W Maintenance screen.

Note: closing the H/W Maintenance menu resets the entire analyzing module.

10.3.6 Clean the Cuvette Cover.

To clean the plastic cover that protects the cuvette ring, remove it and clean it with water or ethanol.

10.3.7 Clean the Incubator Level Sensor

The level sensor controlling the incubator water level is on the left hand side of the incubator. Any dirt deposits on the sensor electrodes will prevent proper detection. This procedure should be followed while the cuvette and the incubator are being cleaned. Refer to the diagram on Figure 10.5 to locate the position of the parts involved in the maintenance.

2. Click on the Drain Water Bath button.

Figure 10.5 - Water level sensor

3. Push the latch in the level sensor connectors and pull both connectors out.
4. The level sensor electrodes are located in the smaller connector. Check the electrodes for dirt. Clean them with a soft cloth or tissue moistened with 2% alkaline detergent. Rinse the electrodes with a soft cloth or tissue moistened with distilled water. Be careful not to bend the electrodes. If the electrode tips show corrosion, replace the sensor.

5. Reinstall the sensor.
6. Close the HW Maintenance menu. The incubator is refilled automatically and the Bath Additive is dispensed into the incubator.

Note: closing the H/W Maintenance menu resets the entire analyzing module.

10.3.8 Clean the Fan Filters

Cooling fan filters are found in several locations on the ILab 600, as shown in Figure 10.6:

1. Behind right front cover : 2 filters
2. Behind left front cover : 3 filters
3. Behind front top cover: 1 filter under the top louver, 1 filter under the middle louver
4. On right-hand side panel. This filter may be either a door-style (hinged) or a removable type:

Figure 10.6 - Filters location

To remove and clean the fan filters follow the steps below:

1. Turn power off. If filters are removed with power on, dust will enter the unit and cause damage.
2. Remove the filters by unhooking the retainer and vacuum-clean the filter element.
3. Reinstall the filters.

10.3.9 Clean the Syringe and Syringe Manifold Filters

Cleaning the Syringe Filters

The filter located in the joint on top of the syringe pump is designed to retain bits of Teflon from the plunger seals. Refer to Figure 10.7 when performing this cleaning procedure:

Figure 10.7 - Syringe filters

1. Open the H/W Maintenance menu.
2. Loosen the tube-fixing nut with your fingers and remove the tube.
3. Loosen and remove the joint with your fingers.
4. Insert a soft stick 1 to 2 mm in diameter (e.g. a toothpick) from the nut side of the joint to remove the filter and rinse it with water.
5. Reinsert the filter into the joint using the soft stick. During insertion, be careful not to damage the end of the filter.
6. Reassemble the joint and finger tighten the nut until the slack disappears, and then tighten a ¼ turn more. Do not overtighten since this will compress the O-ring between the joint and syringe barrel, resulting in poor dispensing accuracy.
7. Close the H/W Maintenance menu.

Note: closing the H/W Maintenance menu resets the entire

analyzing module.

8. Perform 10 Probe Rinsing repetitions using the <Startup> function and check for leakage.

Clean the Syringe Manifold Filter.

The filter located in the joint on top of the pump manifold is designed to prevent dust from entering the solenoid valve of the syringe pump. Refer to Figure 10.8 to clean the syringe manifold filter as follows:

Figure 10.8 - Manifold filters

1. From the H/W Maintenance menu, select Syringe to open the Syringe screen.
2. Locate the Replace Syringe Seal area and choose the syringe to be replaced Sample Syringe / R1 Syringe / R2 Syringe, then click on Move to Replace. The syringe plunger can now be manually moved up and down.
3. The tubes connected to the sample, R1 and R2 syringes are routed from the manifold on the left side of the syringe pump. Loosen the tube fixing nut by hand and slowly pull out the tube. If it is hard to pull out, wrap it with a piece of cloth, grab it gently with pliers and pull with a twisting motion. Loosen and remove the joint with a wrench.
4. Insert a soft stick (e.g. a toothpick) from the nut side of the joint to remove the filter and rinse it with water.
5. Reinsert the filter into the joint using the soft stick. During insertion, take care not to damage the end of the filter.
6. Reassemble the joint, finger tighten the nut until slack disappears, and then tighten an additional ¼ turn. Overtightening will compress the O-ring between the joint and the syringe barrel, resulting in poor dispensing accuracy.
7. Click on Replacement Canceled.
1. Close the H/W Maintenance menu.

Note: closing the H/W Maintenance menu resets the entire analyzing module.

9. Perform the probe water rinsing 10 times using <Startup> and check for leakage.

10.3.10 Replace syringe seals and clean plungers

Follow the instructions below and refer to Figure 10.9 in order to replace the syringe seals and clean the syringe plungers.

Figure 10.9 - Syringe

1. From the H/W Maintenance menu, select the Syringe button to open the Syringe screen.
2. Locate the Replace Seal area and choose the syringe to be replaced Sample Syringe / R1 Syringe / R2 Syringe, then click on Move to Replace. The syringe plunger can now be manually moved up and down.
3. Loosen the two plunger fixing nuts. Hold the upper fixing nut with pliers and loosen the lower nut with a wrench. After that, hold the plunger fixed portion with the pliers and loosen the upper fixing nut with the wrench.
4. Hold down the syringe drum by hand and turn the syringe drum fixing nut counterclockwise up to the top of the thread.
5. Slightly lower the syringe drum and pull it out toward you.
6. Remove the plunger. Water will spill, wipe it with a cloth. Be careful not to bend the plunger shaft (sliding portion) or damage its surface. If there are stains wipe them off with soft gauze.
7. Remove slotted set screw.
8. Remove seal and replace with a new one. Before installing the new packing, check the syringe drum and the new

packing for dirt.

9. Reinstall the plunger.
10. After installation check the plunger for parallelism to the syringe drum. Oblique installation will result in leaks at the seal. Move the plunger up and down about 20 times by hand to wet the seal. A little water on the plunger will speed up the wetting.
11. Click on Replacement Complete to update the replacement record.
12. From the Remove Air area enter 5 times . Click on Remove Air After the reset operation, bubbles are removed from the syringe. Visually check that the bubbles are removed. If bubbles are still present repeat this step until they are completely gone.

Note: the reset operation and bubble removal operation take place simultaneously among the Sample, R1 and R2 dispensers, causing all 3 syringes to move up and down together, regardless of which seal has been replaced.

13. Close the H/W Maintenance menu.

Note: closing the H/W Maintenance menu resets the entire analyzing module.

10.3.11 Clean On-Board Cuvette Cleaner Filters

When particles are found during replacement of the on-board cuvette cleaner bottles, debris in the detergent filter should be washed off .

The filter can be easily removed from the holder by pulling it with tweezers, and the filter can be washed with clean water. Severely blocked filters should be replaced.

10.3.12 Clean and Lubricate Probe and Stirrer Shafts

The arm shafts of the stirrers and probes move repeatedly up and down and may stiffen in the course of time. Clean the arm shafts with a piece of gauze moistened with a Teflon-based lubricant.

10.3.13 Clean Water Inlet Filter.

A filter is fitted to the tube connected to the water inlet port at the rear of the unit. Refer to Figure 10.10 to perform the cleaning of the water inlet filter as follows:

1. Turn analyzer power OFF.
2. Turn OFF power to the water purifier so the water supply will

be shut off.

3. Disconnect the tube connected to the water supply port. Turn the safety ring (gray) counterclockwise to unlock and pull out the plastic joint at the end of the pipe.
4. Remove the filter and clean it. When the filter is removed, water present in the tubing will flow out; have a container ready to catch it.
5. Reinstall the filter and connect the tube to the water supply port, locking the plastic joint by turning the gray safety ring clockwise.
6. Turn power ON to the water purifier.
7. Turn power ON to the analyzer. Make sure there are no leaks.

Figure 10.10 - Pure water inlet filter

10.3.14 Clean the ISE Syringe Plungers

This procedure is necessary in order to remove the salt deposits from the ISE solutions that accumulate on the syringe plungers. Refer to Figure 10.11 for a diagram of the ISE syringe area.

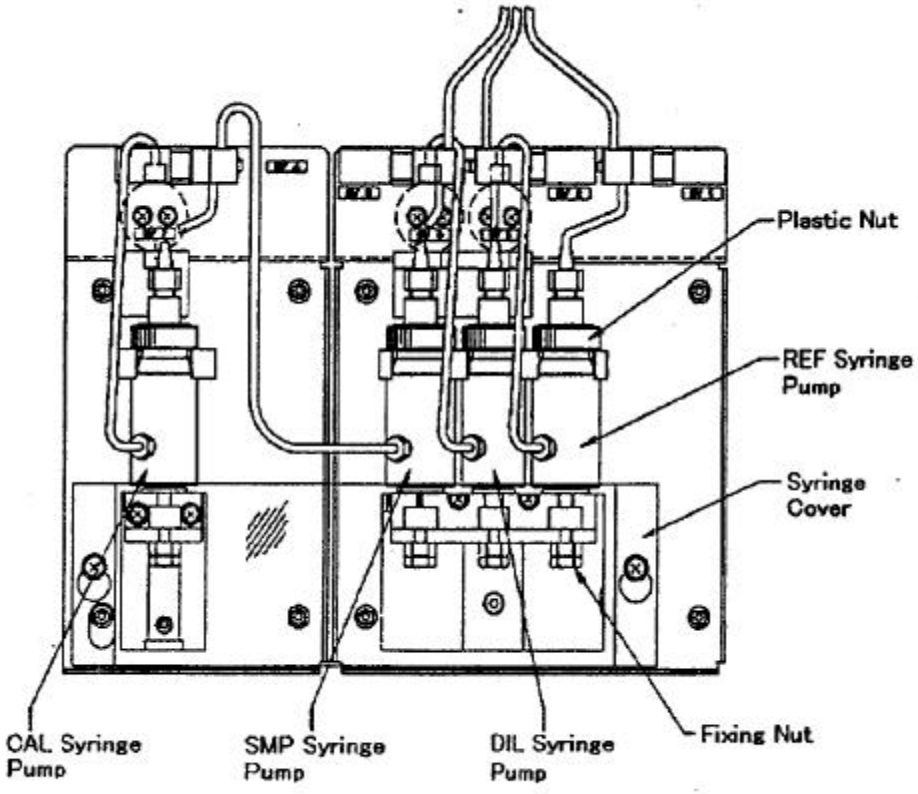
The ISE syringes are protected by a plastic cover that must be removed to gain access to the syringes. Using a Phillips screwdriver, remove the two screws that hold the cover to the module and remove the cover.

The following procedure must be done for the triple syringe (all

three plungers can be cleaned at once) and the Cal syringe plunger. From the ISE Maintenance menu select Syringe to open the ISE Syringe screen and click on the syringe/s to be cleaned (Triple Syringe or CAL Syringe).

In the Vertical area select Down to move the plunger to the bottom position. Without removing the plunger, proceed to clean it thoroughly with a damp cloth soaked in distilled water. When finished, click on Up to move the plunger up and close the screen.

Figure 10.11 - ISE syringe modules



10.3.15 Clean the ISE Sample Dilution Pot

This procedure is necessary in order to remove the salt deposits from the ISE solutions that accumulate in the sample dilution pot. Refer to Figure 10.12 for location of area to be cleaned.

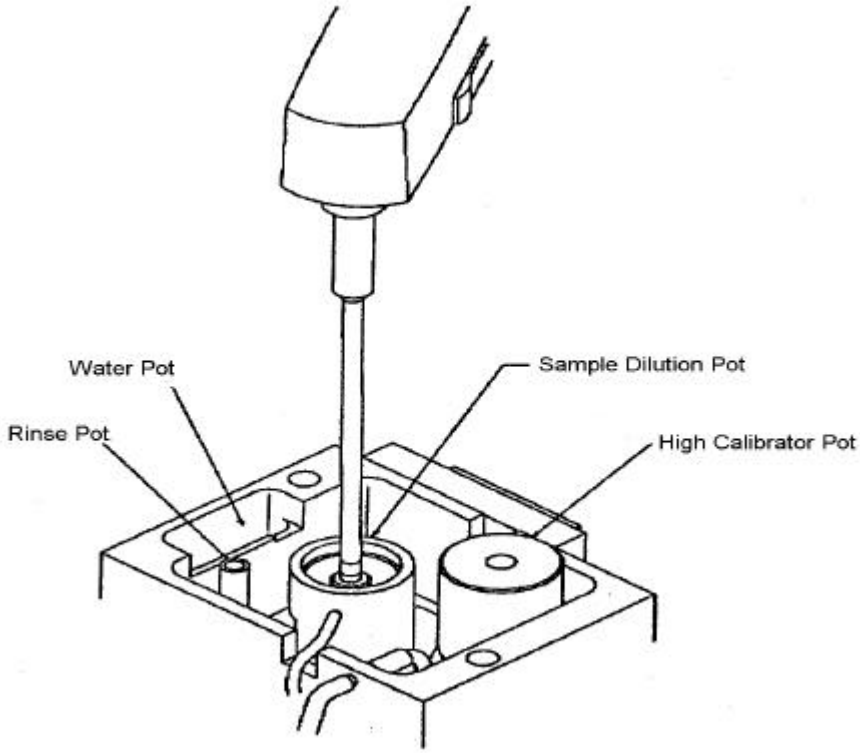
The ISE probe must be moved away from the pot before proceeding with the cleaning. This is done from the ISE Maintenance menu, selecting Probe to open the ISE Probe screen, and clicking on Tension off to release the tension on the probe arm. Once the ISE probe is free and can manually be moved from the position over the pot, remove the crystal deposits on and around the pot by pouring a small amount of

deionized water over the pot and loosening the crystals with a spatula or other similar tool. Be careful not to scratch the plastic with a sharp object. Remove the loose debris and wipe the area clean with a cloth dampened in distilled water.

Close the ISE Probe and ISE Maintenance screens.

Note: closing the ISE Maintenance menu resets the ISE module.

Figure 10.12 - ISE pots



10.3.17 Clean ISE Sample Fluidics

At least once every three months, or as needed, it is recommended to clean the ISE sample line with 2% alkaline detergent. Refer to the following procedure.

1. Open the ISE Maintenance menu.
2. Replace the Na, K and Cl electrodes with the clear dummy block provided in the ILab toolbox.
3. Disconnect the teflon tubing attached to the ISE probe.
4. Fill a 20 cc syringe with 2% alkaline detergent.
5. Using a spare piece of tubing, attach the syringe to the fitting of the ISE probe where the teflon tubing was attached.
6. Slowly move the syringe plunger in and out 20 times to clean the sample lines.

7. Discard the 2% detergent. Fill the syringe with distilled water and rinse the sample lines.
8. Discard the distilled water. Fill the syringe with ISE Diluent and slowly push the diluent into the lines.
9. Disconnect the syringe and re-attach the teflon tubing to the ISE probe.
10. Remove the clear dummy block and re-install the ISE electrodes, making sure that no liquid layer remains in the electrode area.
11. Close the ISE Maintenance menu.

Note: closing the ISE Maintenance menu resets the ISE module.

12. Perform an ISE internal calibration to make sure there is no leakage or errors.

10.3.18 Clean the Waste Tank Level Sensor

The level sensor in the waste tank must be cleaned weekly in order to avoid the accumulation of material on its surface. Since this procedure involves handling parts that are a potential biological hazard, gloves and goggles should be worn for protection.

1. Lift the waste tank cap with the level sensor and place in it a large pan.
2. Soak a cloth with 10% hypochlorite solution and gently wipe the sensor.
3. Rinse with abundant water .
4. Replace the cap with the level sensor back into the waste tank.

10.3.19 Clean the Barcode Reader Window

At least once a month, clean the barcode reader window with a dry cloth.

10.3.20 Replace syringe seals and clean plungers

Follow the instructions below in order to replace the syringe seals and clean the syringe plungers.

1. From the H/W Maintenance menu, select the Syringe button to open the Syringe screen.
2. Locate the Replace Seal area and choose the syringe to be replaced Sample Syringe / R1 Syringe / R2 Syringe, then click on Move to Replace. The syringe plunger can now be manually moved up and down.

3. Loosen the two plunger fixing nuts. Hold the upper fixing nut with pliers and loosen the lower nut with a wrench. After that, hold the plunger fixed portion with the pliers and loosen the upper fixing nut with the wrench.
4. Hold down the syringe drum by hand and turn the syringe drum fixing nut counterclockwise up to the top of the thread.
5. Slightly lower the syringe drum and pull it out toward you.
6. Remove the plunger. Water will spill, wipe it with a cloth. Be careful not to bend the plunger shaft (sliding portion) or damage its surface. If there are stains wipe them off with soft gauze.
7. Remove slotted set screw.
8. Remove seal and replace with a new one. Before installing the new packing, check the syringe drum and the new packing for dirt.

Figure 10.13 - Syringe

9. Reinstall the plunger.
10. After installation check the plunger for parallelism to the syringe drum. Oblique installation will result in leaks at the seal. Move the plunger up and down about 20 times by hand to wet the seal. A little water on the plunger will speed up the wetting.
11. Click on Replacement Complete to update the replacement record.
12. From the Remove Air area enter 5 times . Click on Remove Air After the reset operation, bubbles are removed from the syringe. Visually check that the bubbles are removed. If bubbles are still present repeat this step until they are completely gone.

Note: the reset operation and bubble removal operation take

place simultaneously among the Sample, R1 and R2 dispensers, causing all 3 syringes to move up and down together, regardless of which seal has been replaced.

13. Close the H/W Maintenance menu.

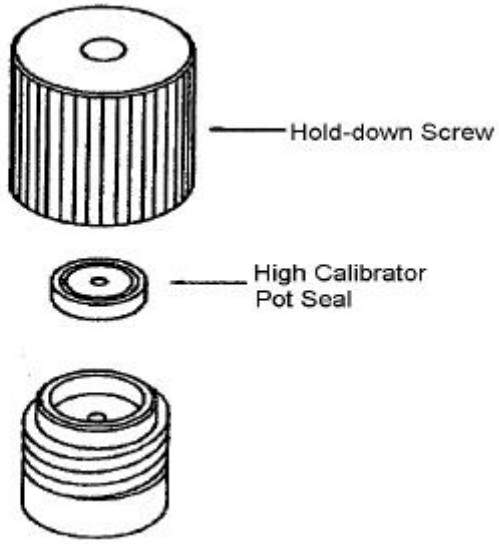
Note: closing the H/W Maintenance menu resets the entire analyzing module.

10.3.21 Replace High Calibrator Pot seal

The seal for the ISE High Calibrator Pot wears out due to the reciprocating motion of the probe during calibration, and must be replaced at regular intervals.

Refer to the diagram on Figure 10.14 to replace the pot seal as you follow the steps below:

Figure 10.14 - Hi Calibrator pot



1. From the ISE Maintenance menu, open the ISE Probe screen.
2. Click on Replace.
3. Turn the arm by hand and remove the hold-down screw of the ISE High Calibrator pot.
4. Remove the seal with tweezers.
5. Install a new seal by pushing it in with your finger. Check the seal to ensure that it is seated correctly and re-install the hold-down screw.
6. Click on Replacement Complete.
7. Close the ISE Maintenance menu.

Note: closing the ISE Maintenance menu resets the ISE module.

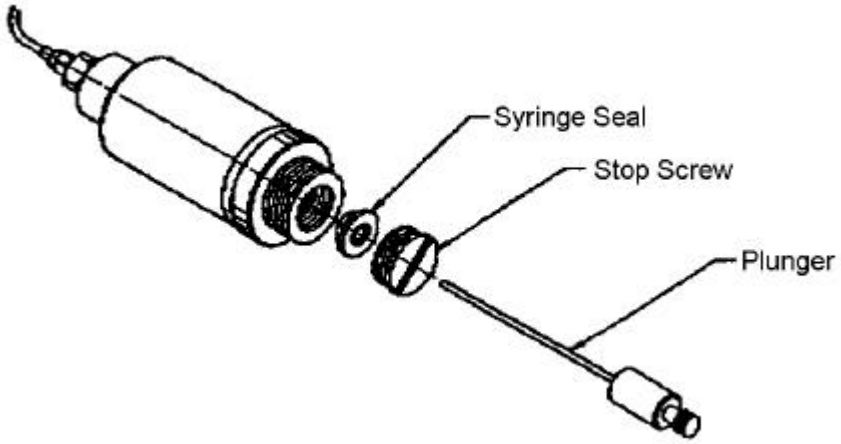
8. After replacement, perform an ISE internal calibration to ensure absence of errors.

10.3.22 Replace the ISE Syringe Seals

Caution: the replacement of a syringe seal must be performed using the ISE Maintenance screen. If this is attempted at other times such as during the ISE calibration, the system may move abruptly and errors/damage may occur.

Follow the steps below and refer to Figure 10.15 when performing the procedure to replace the ISE syringe seals:

Figure 10.15 - Syringe sealer replacement



1. From the ISE Maintenance menu, choose Syringe to open the ISE Syringe screen.
2. Remove the syringe cover by loosening the screws on both sides.
3. Click on Replace and move the syringe plunger to the central position.
4. Pinch the drain tube from the electrode with a tube clamp to prevent the liquid from flowing out.
5. Hold down the syringe drum by hand and turn the syringe drum fixing nut counterclockwise up to the top of the thread.
6. Slightly lower the syringe drum and pull it out toward you.
7. Remove the plunger. ISE solution may spill, wipe it with a cloth. Be careful not to bend the plunger shaft (sliding portion) or damage its surface. If there are stains wipe them off with soft gauze.
8. Remove slotted set screw.

9. Remove seal and replace with a new one. Before installing the new packing, check the syringe drum and the new packing for dirt.
10. Reinstall the plunger.
11. After installation of the syringe, connect the tubing and be sure to remove the tube clamp pinching the electrode drain tube.

Note: during assembly, check that the plunger is set straight. If it is tilted, the result will be liquid leakage and a shortened life for the seal. If more than one syringe seal is being replaced, do them one at a time. Removing more than one syringe at the same time, will result in back flow of liquids and leaks.

12. Install the syringe cover and securely tighten the screw.
13. Click on Replacement Complete to update the replacement date of the seal and return the pump to the initial position.
14. Close the ISE Maintenance menu.

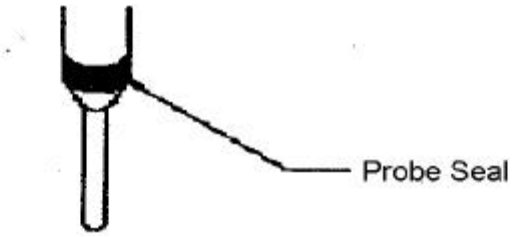
Note: closing the ISE Maintenance menu resets the ISE module.

15. Prime the reagent for the replaced seal by performing an ISE Prime2 through the Startup or Shutdown screens, making sure there are no leaks or clogging.

10.3.23 Replace ISE Probe Seal

To replace the ISE probe seal refer to Figure 10.16:

Figure 10.16 - Probe seal



1. Open the ISE Maintenance menu.
2. Click on Probe to open the ISE Probe screen
3. Click on Replace to raise the probe.
4. Cut and remove the old seal with a cutter.
5. Install a new seal and push it up completely.
6. Click on Replacement Canceled.
7. Close the ISE Maintenance menu.

Note: closing the ISE Maintenance menu resets the ISE module.

8. Perform an ISE internal calibration to make sure there is no leakage.

10.3.24 Replace ISE tubings

Replace the two following tubings (refer to ISE fluidic diagram reported in sec 7 of this manual):

1. Tubing from dilution pot to mixer 1
2. Tubing from mixer 1 to mixer 2

10.3.25 Check Quality of Deionized Water

Only distilled, ion-exchanged or reverse-osmosis source water should be used as the external water supply for the ILab. Check the quality of the deionized water. The water supply pressure must be 0.5 to 3.5kg/cm^2.

10.3.26 Check the Water Level in Cuvettes

This is a visual check to verify that the level of rinsing water is about 2 mm from the top of the cuvette during the washing process.

10.3.27 Check Water Pressure

Open the right front door of the unit. Locate the water pressure gauge (Figure 10.17). Check that the gauge reads the specified 90 kPa as follows (adjust pressure level if required):

1. Open the H/W Maintenance menu. Opening the H/W Maintenance screen automatically starts the water pump to increase the water pressure.
2. Check that the pressure gauge reads 90 kPa mode. If the gauge shows a different value, contact your IL Service Representative.
3. Close the H/W Maintenance menu.

Note: closing the H/W Maintenance menu resets the entire analyzing module.

10.3.28 Check Sample Probe for Damage

If a close-up inspection of the sample probe shows dents or barbs on the probe tip, the tip must be replaced to prevent deterioration of the test

10.3.29 Check Probe and Stirrer Alignment

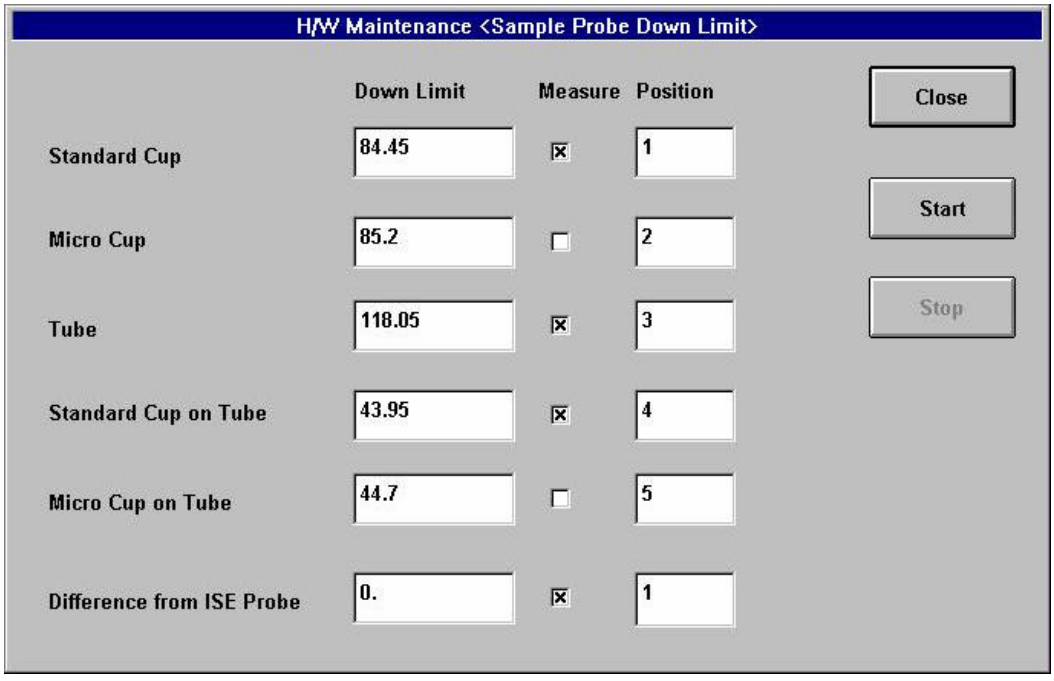
At the completion of the above steps, check the alignment of sample, R1, R2 and ISE sample probes and stirrers 1 and 2

10.3.30 Set the bottom limit of the Sample probe

The bottom position of the sample probe is set according to information related to the sample container type, with the criteria shown below.

* To preserve sampling accuracy, the amount of sample adhering to the probe must be kept at a consistent minimum. This is done by keeping the probe immersion depth constant for the type of container being used and the amount sampled, even if the liquid level drops in the container due to successive samplings. In case of sample cups, the system compensates as well for changes in the geometry of the container as the liquid level gets closer to the bottom
* To prevent the sample probe to hit the bottom of the sample containers causing the shock sensor to work and to stop the sampling, it is not allowed to descend beyond the set bottom limit.
* The sample probe recognizes an insufficient sample based on the preset bottom limit position. An improperly set bottom limit will cause the shock sensor to trigger and report a malfunction, instead of an “insufficient sample” message.

Figure 10.17 - HW Maintenance screen



* The bottom limit must be set as shown below, when the equipment is first installed , when the type of sample container is changed or the probe is replaced.

In order to set the Sample Probe Bottom Limit, Refer to Figures 16.17.

1. Open the H/W Maintenance menu and select Sample Probe Down Limit.
2. Place a sample container of the appropriate type in any position from 61 to 75 of the sample tray. The inner row is chosen for being the one with the most stability.

Note: the Micro Cup and the Micro Cup on Tube options are not used. Do not set the down limit for this type of containers.

3. Click on the check button on the menu for the container chosen and enter the reagent tray position number in use.

Note: for the accurate measurement of the Difference from ISE Probe (which compensates for small differences between the length of the sample probe and the ISE probe), utilize a standard sample cup.

4. Click on Start. The sample tray rotates to the specified position and the probe descends until the shock sensor detects the bottom of the container. A value in mm will be displayed in the Down Limit field of the screen. Repeat two or three times to check for consistency of this value.
5. When finished, close the H/W Maintenance menu.

Note: closing the H/W Maintenance menu resets the entire analyzing module.

6. After reset, shut the unit OFF and then restart. This updates the information on the sample probe down limit.

10.3.31 Setting the Bottom Limit of the Reagent Probe

The bottom position of the reagent probe is set according to information related to the reagent container type, with the criteria shown below.

* To preserve pipetting accuracy, the amount of reagent adhering to the probe must be kept at a consistent minimum. This is done by keeping the probe immersion depth constant for the type of container being used and the amount aspirated, even if the liquid level drops in the container due to successive aspirations.
* To prevent the reagent probe hitting the bottom of the reagent bottles causing shock sensor errors, it is not allowed to descend beyond the bottom limit.
* The reagent probe recognizes an insufficient reagent based on the preset bottom limit position. An improperly set bottom

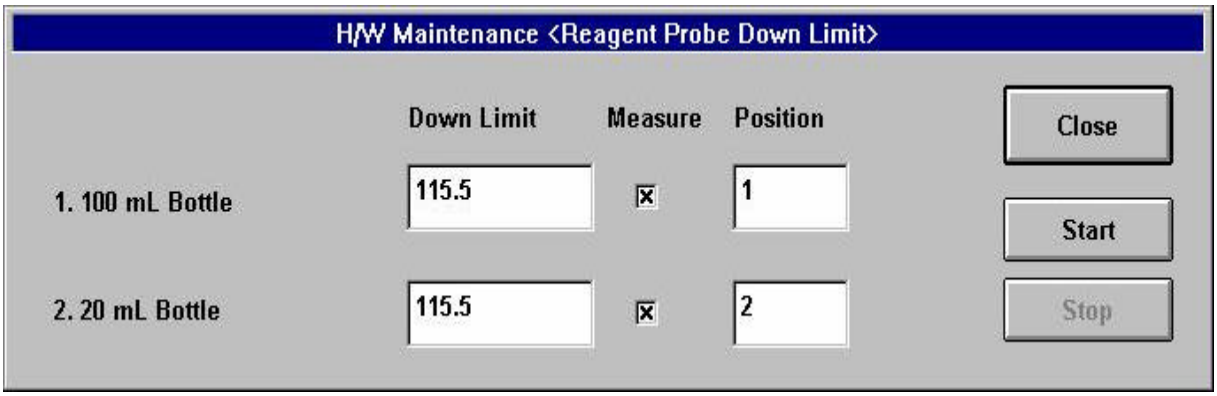
limit will cause the shock sensor to actuate and report a malfunction, instead of an “insufficient reagent” message.

* The bottom limit must be set as shown below, when the equipment is first installed.

In order to set the R1/R2 Probe Bottom Limit, Refer to Figure 10.18 below.

1. Open the H/W Maintenance menu and select Reagent Probe Down Limit.

Figure 10.18



2. Place a 100 mL and a 20 mL empty BoatILs in any position from 1 to 32 of the reagent tray. The inner row is chosen for being the one with the most stability. Make sure that the bottles are vertical. The shape of the bottom of bottles differs depending on the manufacturer. If bottles from different suppliers are used simultaneously, choose high-bottom bottles to do the setting (if a low-bottom bottle is used for the measurement, air may be aspirated from a high-bottom bottle before a probe shock sensor occurs).
3. Click on the check button on the menu for the container chosen and enter the reagent tray position number in use.
4. Click on Start. The reagent tray rotates to the specified position and the probe descends until the shock sensor detects the bottom of the bottle. A value in mm will be displayed in the Down Limit field of the screen. Repeat two or three times to check for consistency of this value.
5. When finished, close the H/W Maintenance menu.

Note: closing the H/W Maintenance menu resets the entire analyzing module.

6. Shut the unit OFF and then restart. This updates the information on the reagent probe bottom limit.

10.3.32 Check the photometer lamp, replace if required

During the analytical verifications, use the water blank in order to evaluate the performance of the lamp. If If poor performances are suspected, replace the photometer lamp

10.3.33 Check electrodes, replace if necessary

Chech carefully the ISE overall performances. Evaluate the Internal Calibration history, the QC performance and the precision test that should be run as part of the analytical verifications. If poor performance of any electrode is found, replace the electrode.

13.10.34 Check and Replace the Cuvette Drying Tip

One of the probes in the cuvette washing unit has a Teflon tip which serves as a wiper of the inside of the cuvette after the cuvette has been washed. As the drying tip wears out, the amount of liquid remaining in the cuvette will increase, resulting in deterioration of the test results. Tip should be replaced one time per year. To replace this tip refer to Figure 10.19 and proceed as follows:

Figure 10.19 - Drying tip replacement

1. From the HW/Maintenance menu, open the Cuvette Wash Station screen.
2. Click on the Tension Off button which allows the cuvette wash station to be moved by hand.
3. Remove the cuvette wash station by loosening the fixing screw by hand.
4. Hold the rinsing probe with one hand, pull off the drying tip slowly.
5. Install a new drying tip. Push the new tip in until the notch hits the stopper on tip of the probe. Be sure not to bend or damage the drying tip.

6. After re-installing the wash station make sure that the drying tip enters properly into the cuvettes by moving manually moving down the wash station.
7. Close the H/W Maintenance screen.

Note: closing the H/W Maintenance menu resets the entire analyzing module.

10.3.35 Check tubing of cuvette washing station, replace if required

Visually check the condition of the tubings connected to the probes of the Washing Station. If they show sign of internal contamination or build-up, replace the tubings.

10.4 Analytical verifications

At the completion of the above procedure, analytical verification should be performed. The following tests are recommended:

1. Run water blank. check results and reset Base Water Blank
2. Run ISE internal calibration
3. Run a precision test selecting indicatively 3-4 chemistries + ISE
4. Run some QC sample and verify the accuracy of the system
5. Verify the accuracy of the QC data stored in the ILab system

For the acceptance specifications, refer to the section 2, Installation, in paragraph Analytical Verifications, or to the chemistry insert sheets.